Water Plant Optimization Study

OTTAWA-LEMIEUX ISLAND WATER TREATMENT PLANT

May 1991

Ontario
Environment
Environnement

ISBN 0-7729-3305-7

WATER PLANT OPTIMIZATION STUDY

Ottawa - Lemieux Island
Water Treatment Plant

Project No. 7-2035

May 1991

PRINTED ON
RECYCLED PAPER
IMPRIMÉ SUR
DU PAPIER RECYCLÉ

Cette publication technique
n'est disponible qu'en anglais.

PIBS 1553
log 89-2302-146

Study conducted by:

G. Zukovs, D. McFayden, P.D. Foley, and G.R. Finch
of
CANVIRO Consultants Ltd.

Under the direction of the
Ottawa Project Committee:

Gary Martin	- MOE Water Resources Branch
Steven Bonk	- Regional Municipality of Ottawa-Carleton
Pat McNally	- Regional Municipality of Ottawa-Carleton
Boyce Hutcheon	- Regional Municipality of Ottawa-Carleton
George Clarke	- MOE Ottawa District Office
Bill Gregson	- MOE Project Engineering Branch
Janusz Budziakowski	- MOE Environmental Approvals Branch
Gerry Sigal	- R.V. Anderson Associates Limited

Address all correspondence to:

Ministry of the Environment
Water Resources Branch
1 St. Clair Ave. W., 4th Floor
Toronto, Ontario
M4V 1K6

Please note that some of the recommendations contained in this report may have already been completed at time of publication. For more information, please contact the local municipality, or the Water Resources Branch of the Ministry of the Environment.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

This Water Plant Optimization Study has been undertaken to determine the existing operating conditions, water quality and potential for optimization and existing unit processes at the Lemieux Island Water Treatment Plant in the Regional Municipality of Ottawa-Carleton. This optimization study is part of an on-going process to assist in providing an up-to-date database on drinking water quality in Ontario through the Drinking Water Surveillance Program (DWSP).

The Regional Municipality of Ottawa-Carleton operates two water treatment plants. In general, Lemieux Island is a well run water treatment plant. Plant performance in terms of both turbidity removal and disinfection has been excellent.

The following sections outline the general findings and recommendations made for the Lemieux Island Water Treatment Plant.

Flow Measurement

The installation of the treated and filtered water venturi meters deviate somewhat from ideal practice. However, flow errors resulting from this deviation are considered to be minimal.

Rapid Mix

At present, the low lift pump impellers are used for rapid mixing. The effectiveness of this practice has been questioned. It should be noted that the Britannia WTP (Project #7.2034) will incorporate a rapid mix stage. A significant improvement in settled water quality may warrant a similar retrofit of rapid mixing at Lemieux Island.

Flocculators

It has been noted that G values in the winter are lower than those prescribed for flocculation basins. Although retention times appear adequate, this does indicate a lack of flexibility for varying plant flows. Nonetheless, the flocculator performance is good. It is recommended that during periods of low flow during the winter months, an evaluation of the removal from service of one set of flocculators be undertaken. This will effectively increase the flow to the remaining flocculators and may result in improved flocculator performance. Alternatively, the installation of hydraulic control devices may provide a more controlled method for increasing G and Gt values.

Settling

It was found that surface and weir loading rates were high, nonetheless, settled water turbidities are generally good. The worst case is in winter flow conditions where turbidities reach 1-2 FTU. The settling basins in the Britannia plant expansion will contain plate settlers. Since there is some indication of short-circuiting, it is recommended that a single basin in the existing plant be isolated and fitted with plate settlers for trial purposes.

Filters

Filter operation is excellent in providing filtered water turbidities generally less than 0.2 FTU for a variety of settled water qualities.

Disinfection

It was found that pre-chlorination dosages and detention times have provided adequate pre-disinfection. Settled water has consistently shown positive free chlorine residuals. Generally, tri-halomethane (THM) levels in treated water were less than 350 µg/L. In order to minimize THM formation, it is recommended that alternatives be investigated such as the use of alternative oxidants (eg. ozone), activated carbon or the movement of chlorine addition to the beginning of the settling basins.

Two concerns with post-disinfection are the limited contact time and the high pH of the water at the point of chlorine addition.

Fluoride

It was found that the hydrofluosilicic acid (HFS) storage area contained no flood wall.

It is recommended that a flood wall be installed to prevent the escape of HFS should a tank leak occur.

pH Control

The existing pH control system produces lime fines. This has been partially controlled by movement of the lime addition point to the head of the clearwell, thereby allowing the fines to settle out in the clearwell as opposed to the distribution system. However, this does not allow for an optimum disinfection environment due to the high pH in the clearwell. The use of a degritter or lime water generator will allow moving the lime addition point back to the clearwell discharge. Alternatively, sodium hydroxide (NaOH) addition does not have the problems of grit associated with lime.

It should also be noted that although the finished water pH is high, it is still midly aggressive.

Therefore, it is recommended that the point of lime addition be moved to the clearwell exit (see lime recommendation) and that the clearwell be baffled to minimize short-circuiting. It is also recommended that chloramination be evaluated as an alternative post-disinfectant.

Coagulant

Based on jar tests, it is recommended that alum continue to be used as a coagulant. Optimization of alum dosing may be required to lower residual aluminum levels in the treated water which has occasionally been higher than 0.1 mg/L. It is understood that the use of a streaming current type monitor for dosage control has been tested at bench scale at the Britannia WTP. However, since alum dosage is based on pH reduction requirements, streaming current was not considered useful.

Coagulant Aid

The point of addition of the coagulant aid may not be optimum for coagulation/flocculation. However, optimization does not appear possible at this time until an expansion takes place.

TABLE OF CONTENTS

CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

INTRODUCTION AND TERMS OF REFERENCE

The Drinking Water Surveillance Program of the Ontario Ministry of the Environment is intended to provide an up-to-date database on drinking water quality in Ontario. In conjunction with DWSP, a specific plant investigation and process evaluation study is desired for each plant entering the program. Consequently, Water Plant Optimization Studies (WPOS) are undertaken to determine the existing operating conditions, water quality, and potential for optimization of existing unit process. Specifically, emphasis has been placed on the particulate removal and disinfection efficiency of the water treatment plant. The Terms of Reference for this study are included in Appendix D.

The Regional Municipality of Ottawa-Carleton operates two water treatment facilities serving a population of approximately 548,000 in 1987. This document is the WPOS for the Lemieux Island Water Treatment Plant (WTP) in the Regional Municipality of Ottawa-Carleton. Figure A1 illustrates the geographical location of each of the two plants.

The Ottawa River raw water is typically high in colour, low in turbidity and with little hardness. Plant performance in terms of both turbidity removal and disinfection has been excellent. Treated water turbidity levels are generally less than 0.2 FTU, and fecal coliforms were detected in only one sample in the period 1983 to 1986.

This report has been organized into the following sections:

Section A - Raw Water Source

This section describes the chemical physical and bacteriological quality of the water treated at the plant.

Section B - Flow Measurement

This section presents a summary of all flow monitoring equipment at the plant.

Section C - Process Components

This section presents descriptions of each of the unit treatment processes, chemical systems and sampling systems existing at the plant.

Section D - Plant Operation

In this section, the methodologies used for operation of the plant in general and with respect to each process component, are presented.

Section E - Plant Performance

This section contains a review of plant particulate removal processes including coagulation, flocculation, sedimentation and filtrations, based on historical performance data. Recommendations are made for improvements to the present system.

Section F - Plant Performance (Disinfection)

This section contains a review of plant disinfection practices based on historical disinfection performance. In addition, there is a discussion on the formation of chlorinated by-products. Concerns to the present system are addressed and recommendations are presented.

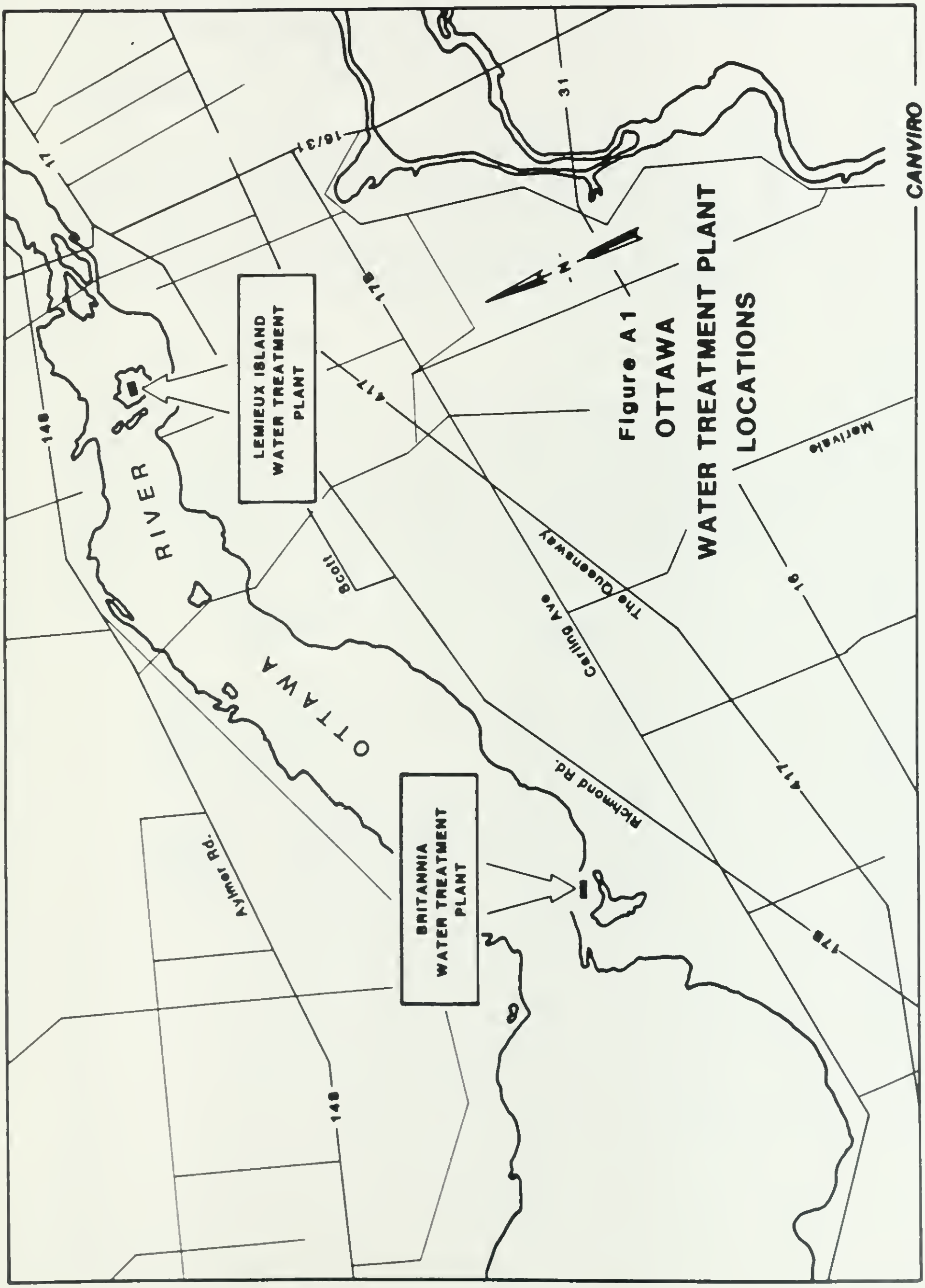


Figure A1
OTTAWA
WATER TREATMENT PLANT
LOCATIONS

A. RAW WATER SOURCE

A.1 Source

The Ottawa river is used as the source of drinking water supply for the Lemieux Island Water Treatment Plant. The plant intake consists of a forebay intake with a port 2m below water level. In 1991 the intake will be modified to allow a submerged river intake outside of the forebay.

A.2 General Quality

The river water is typically high in colour, low in turbidity and relatively soft. Colour is typically 40 - 50 TCU and turbidity is characteristically 2.0 - 2.8 FTU. Total hardness is approximately 31 - 42 mg/L as $CaCO_3$. The overall range of variation for the years 1983 to 1986 for general raw water quality parameters is as follows:

Parameter		Range
Turbidity	(FTU)	0.8 - 25
Colour	(TCU)	25 - 75
Temperature	(^{o}C)	0 - 25
pH		6.8 - 7.6
Alkalinity	(mg/L as $CaCO_3$)	12 - 35
Hardness	(mg/L as $CaCO_3$)	14 - 80
Aluminum	(mg/L as Al)	0.01 - 0.65
Iron	(mg/L as Fe)	0.13 - 0.24

The high colour levels are a result of decayed vegetation and swamp run-off in the heavily forested Ottawa River watershed whose catchment area above the water treatment plant intake is approximately 89 600 km^2. Turbidity levels in the raw water vary on an annual cycle with the highest levels (4-9 FTU) occurring in the spring coincident with snow melt and precipitation. The lowest levels occur in late summer and early fall where turbidity drops to 1-2 FTU and remains there during the winter. Colour levels are more or less constant over the year with a slight decrease in monthly averages being observed in late summer and early fall.

Table 2.0 (Appendix A) presents raw water turbidity, colour, temperature and pH data for the years 1983 - 1986. This data was obtained from daily in-plant analyses. Alkalinity, hardness and aluminum data were also obtained from in-plant analyses. Alkalinity measurements were made daily while hardness was measured weekly. Section D.6 presents details of sample and analysis frequencies, sampling procedures and test methods for selected parameters.

Additional raw water quality data for physical-chemical parameters, heavy metals, trace organics and bacteria are presented in Table 4.0 for the period September 1986 to June 1987, (partial data only for June, 1987). These results were derived from sampling and analysis performed under the Drinking Water Surveillance Program (DWSP).

River water bacteriological quality is variable with total coliform densities ranging from 2 CFU[1]/100 ml to 630 CFU[1]/100 ml for the period 1983 to 1986. Fecal coliform densities typically ranged from 18 to 35 CFU[1]/100 ml. Bacteriological analyses were performed by the Ontario Ministry of Health Laboratories, Ottawa, daily.

[1]CFU - colony forming units

Discussions with MOE staff in Ottawa have indicated no industrial dischargers are located in proximity of the Lemieux Island Water Treatment Plant.

Algae counts ranged from zero to 372 ASU[2] during the period 1983 to 1986. As may be expected algae increased during the months of May, June, July. Algae enumerations are performed by the in-plant laboratory once per month. Details of raw water algae and bacteriological analyses are presented in Tables 5.0 and 6.0 to 6.3 in Appendix A, respectively.

[2] ASU - aerial standard units

B. FLOW MEASUREMENT

Table B.1 contains a summary of all flow measurement and monitoring at the Lemieux Island Water Treatment Plant.

Once per year a calibration of each flow measurement device is carried out by the Electrical Instrument Section. This involves the use of Druck DP calibrator or a standard water column which is then connected to each Bristol Differential Pressure Transmitter. The recorder value is then checked for accuracy and adjustment of the transmitter is made if necessary. A calibration of any DP cell is also made, as required, if a discrepancy occurs.

The Druck DP calibrator is calibrated against a standard mercury manometer.

The raw, treated and filtered installations generally conform with accepted metering practice. The approach pipe sections upstream of the treated and filtered water venturis are minimal in length (only 3 diameters of straight unobstructed pipe for the treated water venturis and less than one for the filter effluent venturi). A small but undefinable degree of inaccuracy likely results from this deviation from ideal practice.

Table B.1
FLOW MEASUREMENT
LEMIEUX WATER TREATMENT PLANT

Service	Number	Type/Size	Capacity Range (each)	Transmitter	Location	Instrumentation
Raw Water						
West	1	VENTURI 1680 x 770 mm	382 ML/d @ 6924 mm	Bristol DP 4-20 mA	Low Lift Discharge	- 7 day chart recorder with integrator
East	1	VENTURI 1220 x 770 mm	227 ML/d @ 1470 mm water column	Bristol DP 4-20 mA	Low Lift Discharge	- No instrumentation
Filter Effluent	12	VENTURI 480 x 330 mm	40.9 ML/d @ 1325 mm water column	Bristol DP 4-20 mA	Filter Effluent Pipe	- Digital indicator on filter console
Treated Water						
High Lift Pumps 1 & 2	2	VENTURI 915 x 460 mm	114 ML/d @ 6576 mm water column	Bristol DP 4-20 mA	Pump Discharge	- local indicator
Pumps 3 & 4	2	VENTURI 762 x 460 mm	164 ML/d @ 6526 mm water column	Bristol DP 4-20 mA	Pump Discharge	- local indicator
Plant Effluent Lines						
East	1	VENTURI 1680 x 710 mm	382 ML/d @ 7030 mm	Bristol DP 4-20 mA	East Header	- 7 day chart recorder with integrator
West	1	VENTURI 1220 x 560 mm	250 ML/d @ 6924 mm	Bristol DP 4-20 mA	West Header	- No instrumentation
Backwash Water	1	VENTURI 762 x 550 mm	164 ML @ 2685 mm water column	Bristol DP 4-20 mA	Pipe Gallery	- digital indicator on the filter console

C. PROCESS COMPONENTS

C.1 General

The Regional Municipality of Ottawa-Carelton's water distribution service is divided into Pressure Zones, each with varying flow and pressure requirements. Water is conveyed from the two purification plants into the system via a network of trunk feedermains and pump stations which interconnect the zones.

Originally, only electrically driven high-lift pumps were located at the Island supplying raw Ottawa River water as drinking water. The Lemieux Island Water Treatment Plant was designed by Gore and Storrie Ltd. and constructed in 1932. The existing plant is very similar to the Britannia Water Treatment Plant. It is a conventional plant for treating surface waters. Unit processes consist of prechlorination, coagulation, flocculation, sedimentation, rapid sand filtration, pH adjustment for corrosion control, fluoridation and post-chlorination. The coagulation process uses liquid alum as the primary coagulant and activated silica as a coagulant aid.

The plant is currently undergoing an extensive automation program that will result in comprehensive computer control over plant operation. Figure C1 is a process flow-sheet for the existing plant. Figures C2, C3 and C4 present the Lemieux Island site plan, piping and process diagram and detailed block schematic respectively.

C.2 Design Data

a) Plant Capacity

The Lemieux Island Water Treatment Plant can produce a maximum of 340 ML/d. Beyond this capacity the flocculators begin to flood. As well, this rate can only be sustained for an estimated 6 to 8 hours as sufficient water for back-washing purposes is not produced.

The process range is between 260-295 ML/d in the winter and 330-362 ML/d in the summer. The plant nominal rated capacity as per the Regional Municipality of Ottawa/Carleton (RMOC) "Water Purification Plants Master Plan, May 1985" is 290 ML/d.

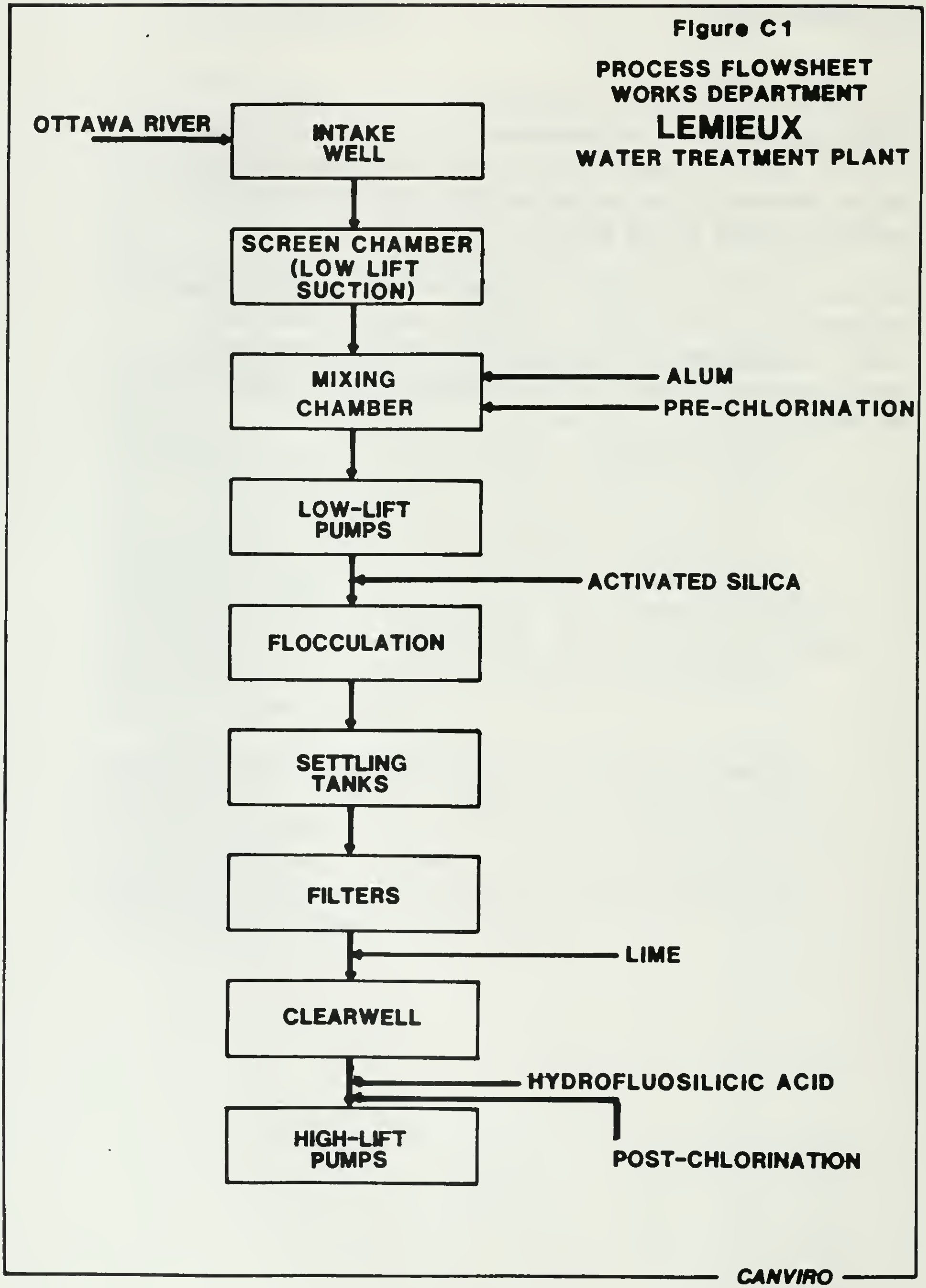


Figure C1
PROCESS FLOWSHEET
WORKS DEPARTMENT
LEMIEUX
WATER TREATMENT PLANT
OTTAWA RIVER
INTAKE WELL
SCREEN CHAMBER (LOW LIFT SUCTION)
MIXING CHAMBER
ALUM
PRE-CHLORINATION
LOW-LIFT PUMPS
ACTIVATED SILICA
FLOCCULATION
SETTLING TANKS
FILTERS
LIME
CLEARWELL
HYDROFLUOSILICIC ACID
POST-CHLORINATION
HIGH-LIFT PUMPS
CANVIRO

C.3 Process Component Inventory

a) Intake

Raw water from the Ottawa River enters the suction well of the pump house through a port 2 m below water level. The suction well in turn is connected to the intake well by a steel and concrete diaphragm to which is connected a 1.8 m x 2.1 m sluice gate. Plate 1 shows the forebay intake to the plant. Plate 2 shows the main intake header and gate valve. In 1991 the intake will be modified to allow a river intake outside of the forebay.

b) Screens

Raw water screening is accommodated by two manually cleaned wire mesh screens with 95 mm openings followed by 2 secondary screens with 12 mm openings. Each of the secondary screens have dimensions 64 mm x 2.7 m x 3.95 m. Screen flows in turn discharge into a concrete low-lift chamber (suction well) having a volume of 145 m^3 (8.2 m x 5.8 m x 3.05 m). Flow velocity through one screen at the plant rated capacity of 290 ML/d is 0.49 m/s which is within the MOE guideline (Ref. C-1) of 0.9 m/s for a dual mechanically cleaned screen system with one screen out of service. Plate 3 shows the top of the wire mesh screens.

Screen operating problems include some clogging and frazil ice problems in the winter. Modifications to the intake in 1991 should alleviate these problems.

c) Low-Lift Pumping

The pump house contains 4 low-lift pumps, all installed in 1931. Pump specifications are provided in Table C.3.1. The low-lift discharge header divides into two branches. One branch supplies flocculator sets 1, 2, and 3 while the second branch supplies flocculator sets 4 and 5.

Table C.3.1

LOW LIFT PUMPING

	Pumps 1,2	Pump 3	Pump 4
Capacity	95.5 ML/d	95.5 ML/d	159 ML/d
T.D.H.	14.6 m	14.5 m	14.5 m
r/min	595	595	375
Motor	C.G.E.	English	Reliance
Size	261 kW	261 kW	373 kW
Installed	1931	1931	1931

The combination of low lift pumps, used at a given time, is determined by the Shift Supervisor in consideration of historical demand (time of day, time of year) and current storage levels. Low lift pumps are throttled on the main discharge line by a single modulating valve utilizing a feedback signal from the water level in the settled water duct. Details of flow control are presented in Section D.2.

Plate 9 shows the Lemieux Island low lift pumps.

Standby power is provided by two diesel generators which have the following specifications:

Diesel Generator No. 1

Driver:	Waukesha
Generator:	Brown-Boveri
KVA:	1250
RPM:	1200
Volts:	2300
kW:	1000

Diesel Generator No. 2

Driver:	Cummins
Generator:	Brown-Boveri
KVA:	250
RPM:	1800
Volts:	600/347
Kw:	200

d) Rapid Mixing

Alum and chlorine for pre-disinfection are added after the screens prior to the low-lift pumps so that rapid mixing is provided by the low-lift pumps. There is no mechanical mixing per se. Alum is fed through a 19 mm PVC feedline to a T-diffuser with eight drop legs. Thus, floc formation has begun before the water reaches the flocculation tanks. Sodium silicate is fed to a V-notch weir box through a 50 mm ABS flexible hose, then fed through ten 19 mm hoses to each cell to enhance flocculation.

The total line and tank volume prior to the flocculators is as follows:

	Volume
Low Lift Pump Well	145 m^3
Low Lift Discharge Line	96.7 m^3
(one 1200 mm @ 85.0 m long)	
(twin 600 mm @ 2.1 m long)	
Total Volume	241.7 m^3

For various design flowrates the following nominal retention times can be calculated:

Rated Capacity	(290 ML/d)	1.2 min
Peak Capacity	(340 ML/d)	1.03 min

These retention times are typical for conventional rapid mix times. However, the effectiveness of mixing with low lift pumps has been questioned and the practice is generally discouraged (Ref C-1).

e) Flocculation

The Lemieux Island WTP is provided with two groups (old and new) of spiral flow (hydraulic) flocculators. The original group was installed in 1931 and the new flocculation tanks were installed in 1978. Cell descriptions, dimensions, nominal detention times and root mean square velocity gradient (G) values for peak and rated capacities for a worst case water temperature of 0°C are given in the following:

Lemieux Island Flocculation Data

	Old	New
No. of tanks	3	2
No. of stages	4	3
No. of cells per stage	2	2
Volume/cell (m^3)	190	253
Detention time @ 290 ML/d (minutes)	38	38
Detention time @ 340 ML/d (minutes)	32	32

Port sizes for the flocculation cells are constant giving no tapered flocculation. Ports in the old basins measure 0.6 m x 0.9 m. The new basins have ports measuring 0.76 m x 1.05 m.

Lemieux Island Flocculation Data

	Old	New
(1)G at 290 ML/d (sec^{-1})	16	11
(1)G at 340 ML/d (sec^{-1})	20	14
(1)Gt at 290 ML/d	36,480	25,080
(1)Gt at 340 ML/d	38,400	26,880

Notes: (1) calculated for a water temperature of 0°C.

Nominal flocculator detention times exceed the suggested MOE minimum Guideline (Ref C-1) of 30 minutes even at the peak capacity of 340 ML/d. Velocity gradient values and the Gt product fall below minimum recommended Gt values for the new basins while the old basins achieve what might be considered minimum values.

The 5 sets of tanks discharge into 5 settling basins. Exit velocities from the flocculation tanks into the settling basins are as follows:

	Exit Port Sizes	Velocity (m/s) 290 ML/d	340 ML/d
Old	0.3 m x 0.61 m (12 per settling basin)	0.61	0.72
New	1.47 m x 1.30 m (2 per settling basin)	0.09	0.11

Due to the high exit velocities from the old flocculation tanks some floc breakup may be occuring.

f) Settling Basins

Each group of flocculators are provided with an equivalent number of settling basins. The old flocculators feed 3 settling basins with dimensions 85 m x 9.5 m x 8.7 m and having an overall volume of 21 097 m³. Two new settling basins were installed concurrently with the new flocculators

in 1978. The new settling tanks have dimensions of 82 m x 9.9 m x 8.5 m and an overall volume of 13,914 m^3.

Manual sludge removal is employed in the old tanks while the new tanks have been provided with floating siphon type collectors.

At the various capacities the settling tanks have the following retention times, overflow rates and weir rates:

	Retention time (min)		Surface Overflow Rate (m/h)		Weir Rate	
	Old	New	Old	New	Old(1)	New
Plant Rated Capacity 290 ML/d	158	158	2.96	2.93	-	1321
Peak Capacity 340 ML/d	149	149	3.51	3.51	-	1550

Note: 1) The old settling basins utilize a sluice gate discharge as opposed to a weir.

The overflow rates for both old and new exceed the MOE Guidelines which specify a maximum overflow rate of 2.4 m/h for rectangular sedimentation tanks. The Ministry Guidelines (Ref. C-1) suggest that weir loading rates should not exceed 200 m^3/d.m. The existing weir loading rates are 7 to 8 times higher than the recommended maximum. Although these are not standard weirs, there might still be cause for concern that the high rates can affect the velocity profiles in the settling basins.

The new basins contain a submerged launder collection system described below:

Launder diameter: 76.2 cm dia

Launder length:	7.3 m
Launder orifices:	76 mm
Number of orifices per launder:	94

The old basins have a 9.1 m weir with a higher 1.2 m section in the middle that is connected to the drain (overflow). The basins are normally operated at the level above the weir, filling the collection trough and then discharging through the 1.5 m² sluice gate.

Velocities at the various flows are as follows:

Rated Capacity	(290 ML/d)	-	0.29 m/s
Peak Capacity	(340 ML/d)	-	0.52 m/s

Although velocities are low they may still contribute to short circuiting.

Plate 14 shows the inlet to settling basins 4 and 5. Plate 15 shows the floating siphon sludge removal mechanism.

g) Filters

The filter building contains 12 filters (header and lateral underdrain) each 17.1 m long x 8.23 m wide with a total depth of 1.41 m. Each filter bed has the following composition:

Material	Limiting Size (mm)	Depth (mm)
Gravel No. 1	50 - 38	102
Gravel No. 2	38 - 25	102
Gravel No. 3	25 - 12.5	102
Gravel No. 4	12.5 - 4.7	76
Gravel No. 5	4.7 - 2.4	76
Sand No. 1	2.4 - 1.2	51
Sand No. 2	1.4 - 0.35	343
Anthracite	0.95 - 0.82	559

Effective size for the sand ranges from 0.85 to 0.90 with uniformity coefficients ranging from 1.5 to 1.7. The effective size for the anthracit range from 0.85 to 0.87 with uniformity coefficients ranging from 1.6 to 2.0. These values are based on lab analysis at the time of delivery.

Settled water enters each filter through a 600 x 1200 mm Armco-Rotork electronically controlled sluice gate. Flow to the filters is controlled using a BIF Model 251-02 water level transmitter located in the settled water duct. This signal will cause the modulating control valve on the low-lift pumps to either open or close depending on the level in the settled water duct. The settled water duct also has a Warrick Michigan Type 3E3B19 low level alarm. Water drains from the filters through perforated 80 mm lateral underdrains.

Water is distributed over the filters from the backwash troughs. This type of distribution prevents scouring of the anthracite which was occurring when the feed originated directly at the end of a filter bed. However, this particular distribution configuration does increase the amount of washwater requiring disposal, because the inlet duct containing settled water must be drained to waste at the start of a backwash.

Filter rates at the various capacities are as follows:

Plant Rate Capacity	290 ML/d	8.1 m/h
Peak Capacity	340 ML/d	9.5 m/h

These values were calculated assuming only 11 out of 12 filters in operation with one in backwash mode. MOE Guidelines (Ref. C-1) suggest a maximum filtration rate of 12 m/h. At peak capacity Lemieux Island is well within this range.

Backwash water is pumped from the clearwell up through the filters using one of two backwash pumps. Both are Worthington Type 24 MC-1 split case end suction horizontal pumps each with a capacity of 142 ML/d at a T.D.H. of 11.5 m (585 RPM). Driving each pump is a Tamper induction motor rated at 224 kW. Both the suction and discharge are provided with 600 mm butterfly valves.

Backwashing frequency is determined by a number of factors. Effluent turbidity breakthrough of 0.5 NTU or 1.5 m headloss indicate the necessity of backwashing the filter. In this process clearwell water is pumped back through the filter bed at a high rate (118 ML/d) dislodging material originally trapped by the media. Surface wash agitators sweep across the surface of the filter bed in a circular motion to aid the cleansing process. Each backwash consumes approximately 450 m^3 of treated water which is discharged into a wash-water trough for subsequent disposal to waste. Total wash-water consumption accounts for 2 - 3% of plant production. At 118 ML/day the high wash rate through a filter is 35 m/h. This creates a bed expansion of approximately 150 to 200 mm or 16% to 21%. By comparison MOE Guidelines suggest a backwash rate of 45 m/h and a bed expansion of 30%. A detailed description of the backwashing procedure can be found in Section D.4.

Plate 18 shows the filter beds. Plate 19 shows a surface agitator.

h) Clearwell

Treated water is stored in a single clearwell whose dimensions are 114.6 m long x 40.2 m wide x 6 m deep. It has a total volume of 27 000 m^3.

The clearwell water level is measured by an ultrasonic level sensor. Retention time of the clearwell at the various capacities is:

Plant Rated Capacity	(290 ML/d)	-	134 minutes
Peak Capacity	(340 ML/d)	-	114 minutes

The clearwell volume is sufficient to allow draw down in periods of high demand while maintaining a constant filtration rate.

i) High-Lift Pumping (and Diesel Stand-by)

Water is pumped into the distribution system using four electric high lift pumps. One diesel generator is also available to provide power to the pumps in case of a power failure situation. The small generator is sized to carry the plant service only (lighting, instrumentation). Table C.3.2 gives the detailed specifications for the pumps. During hydro restrictions, Lemieux Island has an agreement with Ottawa Hydro to use its diesel generator. This generally occurs in the morning and/or early evening. High lift pumping is also available using the hydraulically turbine driven pumps at the Fleet Street Pumping Station. Water from the clearwell flows by gravity to Fleet Street where 5 pumps are available. During the hydro restrictions, Fleet Street will do the high lift pumping, while the generator provides power for the low lift pumps.

j) Waste Disposal

There is currently no waste treatment at the Lemieux Island Water Treatment Plant. Washwater drains into the Ottawa River for disposal.

Table C.3.2

HIGH LIFT PUMPING SPECIFICATIONS

PUMP NUMBER	1	2	3	4
Type	Ingersol Rand	Allis Chalmers	Allis Chalmers	Allis Chalmers
Capacity (ML/d)	136	136	64	64
T.D.H. (m)	64	64	64	70
r/min	720	880	900	900
Motor	Westinghouse	Brown Boveri (elec.) or Waukesta (diesel)	Canadian General Electric	Canadian General Electric
Size (kW)	1118.5	1118.5	708	708
Installed	1954	1975	1931	1934

C.4 Chemical Systems

a) Disinfectant

Supplier

Chlorine gas is delivered in 910 kg containers. It is supplied by the Stan-Chem Business Unit of CIL Ltd. out of Montreal, Quebec. However, the supplier may change on an annual basis, as per the tender process.

Storage

There are usually a total of 26 full and empty containers stored at Lemieux. Three Fairbanks and Morris scales support a total of six containers that are feeding the system at any given time. Plate 6 shows the chlorine containers on the scales.

Equipment

The six cylinders feed two Wallace and Tiernan Series 50-202 chlorine evaporators having a total capacity of 3630 kg/day. These evaporators discharge into a total of five Wallace and Tiernan V-800 chlorinators.

Capacity:	910 kg/d per chlorinator (each evaporator has a capacity of 1140 kg/day)
Feed Ratio:	20:1

Water is supplied from the plant service and is mixed with the chlorine by means of an injector. Dosage is controlled by manual adjustment at the chlorinator.

Application Point

Pre-chlorine is fed through a diffuser located downstream of the screens just prior to the low lift pump suction well. Post-chlorine is fed into the suction line of the high lift pump approximately 8 m after the clearwell.

b) Coagulant

Supplier

Liquid alum ($Al_2 (SO_4)_3$ - 14 H_2O) used as the primary coagulant at Lemieux Island is supplied by General Chemical Ltd. of Montreal. It is delivered from Valleyfield, Quebec. This may change on an annual basis as per the tender process.

Storage

The liquid alum is stored in a 96.3 m^3 storage tank. There is also a 48.1 m^3 standby storage tank which is used in situations where liquid alum levels in the main tank are low.

Equipment

The alum is fed from the storage tanks into a pair of BIF Model 65-01 Roto-Dip feeders with a feed rate range of 22 to 8100 L/hr. The Roto-Dip feeders are due to be replaced by two Wallace and Tiernan Series 43 metering pumps at the beginning of 1988. Plates 4 and 5 show the Roto-Dip alum feeders.

Application Point

The main liquid alum injector is a diffuser located on the downstream side of the screens prior to the low lift suction well. Another injector is not provided with a diffuser and is used as a backup in case of failure of the main injector. It is located beside the main injector.

c) Coagulant Aid (Activated Silica)

Supplier

Activated silica is used as the coagulant aid. Sodium silicate (28%) is supplied by National Silicates of Montreal, Quebec.

Storage

Sodium silicate is stored in a 7.5 m^3 storage tank as shown in Plate 10.

Silica activation occurs when a sodium silicate solution is neutralized to a pH less than 9. This reaction must be stopped, however, prior to precipitation formation by dilution to a concentration of about 0.002 molar. Usually, acid is used for activation, however due to the availability of alum, modifications were made to the Lemieux Island silactors which allow the use of alum for silica activation.

Equipment

Silica activation occurs when a sodium silicate solution is changed to a pH less than 6. This reaction must be stopped, however, prior to precipitate formation by dilution to a concentration of about 0.002 molar. Acid or chlorine may be used for activaton, however, due to the availability of alum, modifications were made to the Lemieux silactors which allow the use of alum for silica activation.

The alum activation system for the silactors is easier to maintain since the only problem is gel formation in the lines and not crystalline scaling. As well, alum is much easier to handle than chlorine. The volume ratio of alum to silicate fed to the silactor is 2:1. Water from the plant service is also fed at approximately 115 L/hr which gives a water:alum/silicate ratio of 10:1. There are also two sulphuric acid pumps each with a capacity of 1.5 L/min. These are used to automatically clean and flush the silactors every two to three hours. Alum and sodium silicate (28%) are each fed into two ACTISOL silactors using either a Milton Roy or Wallace and Tiernan pump.

In 1988, the Milton Roy will be replaced by a Wallace and Tiernan Series 44 pump.

Application Point

Activated silica is transported from the silactor through a 50 mm line to a set of distributions weirs directly over the stillwells. These weirs provide an even flow of silica to each flocculation chamber through a 19 mm line. Plate 12 shows the silica addition points.

d) Fluoride

Supplier

Hydrofluosilicic acid (HFS) 25% is supplied by the Stan-Chem Business Unit of CIL Ltd., Montreal, Quebec.

Storage

The HFS is stored in a modified 54.5 m^3 storage tank. This tank feeds a 0.68 m^3 day tank. Plate 32 shows the main storage tank and Plate 33 shows the day tank. The storage tank was formerly the dry alum storage bin. The bin has been fitted with a PVC liner. It should also be noted that no flood wall exists around the HFS storage tank. It is recommended that a berm be constructed for spill containment.

Equipment

Carrying water is supplied by the plant service and pumped along with the HFS by either of a pair of Wallace and Tiernan U-24656 metering pumps. The pumps are controlled by an SCR Unit and are flow paced.

Application Point

The mixture is fed through a comb-shaped PVC diffuser which is located where the suction header exits from the clearwell.

e) pH Control

Supplier

Lime (Pebble Quick) is used for pH control of the plant effluent to reduce corrosion problems in the distribution system. The lime is supplied by Graybec Ltd., a Division of Jolichaux Ltd., of Montreal, Quebec.

Storage

Dry lime is stored in two 136 tonne storage hoppers. Plate 23 shows the top of the lime storage hoppers.

Equipment

Lime is fed by two Wallace and Tiernan WC9LM9 Belt Feeders at 550 kg/h total into two BIF Model 41-02 lime slakers which discharge into a constant level solution tank. Water for the slakers is drawn from the plant service and is mixed with the lime at a ratio of 4:1. This gives a slurry concentration of approximately 20 g/L. Plate 24 shows a slaker.

Application Point

The lime solution is then fed into 9 distribution lines to the filter effluent pipes of the first nine filters. Plate 20 shows the application point on one pipe.

C.5 Sampling

The Lemieux Island WTP is provided with sample lines for raw water, filtered effluent (prior to lime addition) and plant effluent. All sample lines are constructed of copper tubing. All three sample lines terminate in the plant lab. Plate 31 shows the in lab sample taps.

Raw water is sampled at the intake well and is pumped to the lab by a 0.37 KW centrifugal pump. Filter effluent is also pumped to the lab by a 0.37 KW centrifugal pump. All pumps operate continuously. All pump impellers and housings are stainless steel in accordance with the requirements of the DWSP program. Table C.5.1 presents details of in-plant sample lines. Section D.6 details the frequency and types of analyses performed.

A sample is also drawn from each filter effluent pipe and used in the filter turbidity scan. Grab samples of raw and treated are also taken daily and composited for a weekly sample. Section D.6 also contains a summary of grab sample points. Samples of finished water are composited to evaluate daily flouride levels. Weekly composite samples are taken for fluoride and silica.

Table C.5.1

DETAILS OF IN-PLANT SAMPLE LINES

Source	Length/Size (m/mm)	Flow (L/min)	Velocity (m/s)	Travel Time (min)
Raw Water from the intake well	90/19	3.5-5.5	0.2-0.3	4.5-7.5
Filtered effluent line prior to lime addition.	20-65/12.7	3-4	0.4-0.55	0.6-2.7
Plant effluent on discharge side of high lift headers.	80/19	8-10	0.45-0.6	2.2-3.0

C.6 Process Automation

The Lemieux Island WTP is currently undergoing extensive automation which will result in comprehensive computer control over plant operation. Known as the Supervisory Control and Data Acquistion (SCADA) System, it will initially be used for data logging and allow manual control of plant operation from a central system. Eventually control programs will be developed that will automatically perform such tasks as backwashing and chemical dosage adjustments. It is expected that this process will be in operation in 1989.

C.7 Standby

Lemieux Island has two diesel generators as described in Section C.3(c). Under standby operation (ie. in the case of power failure) one generator is used to provide power to the low lift pumps and the other is used to provide service to the rest of the plant. There is also one diesel generator to provide power to the high lift pumps. However, usually high lift pumping is provided by the Fleet Sheet Pumping Station which is gravity fed from Lemieux Island and utilizes waterwheel power. It has a capacity of 180 ML/d.

C.8 Drawings

a) Site Plan For Lemieux Island
b) Piping and Process Diagram
c) Block Schematic
d) Plates

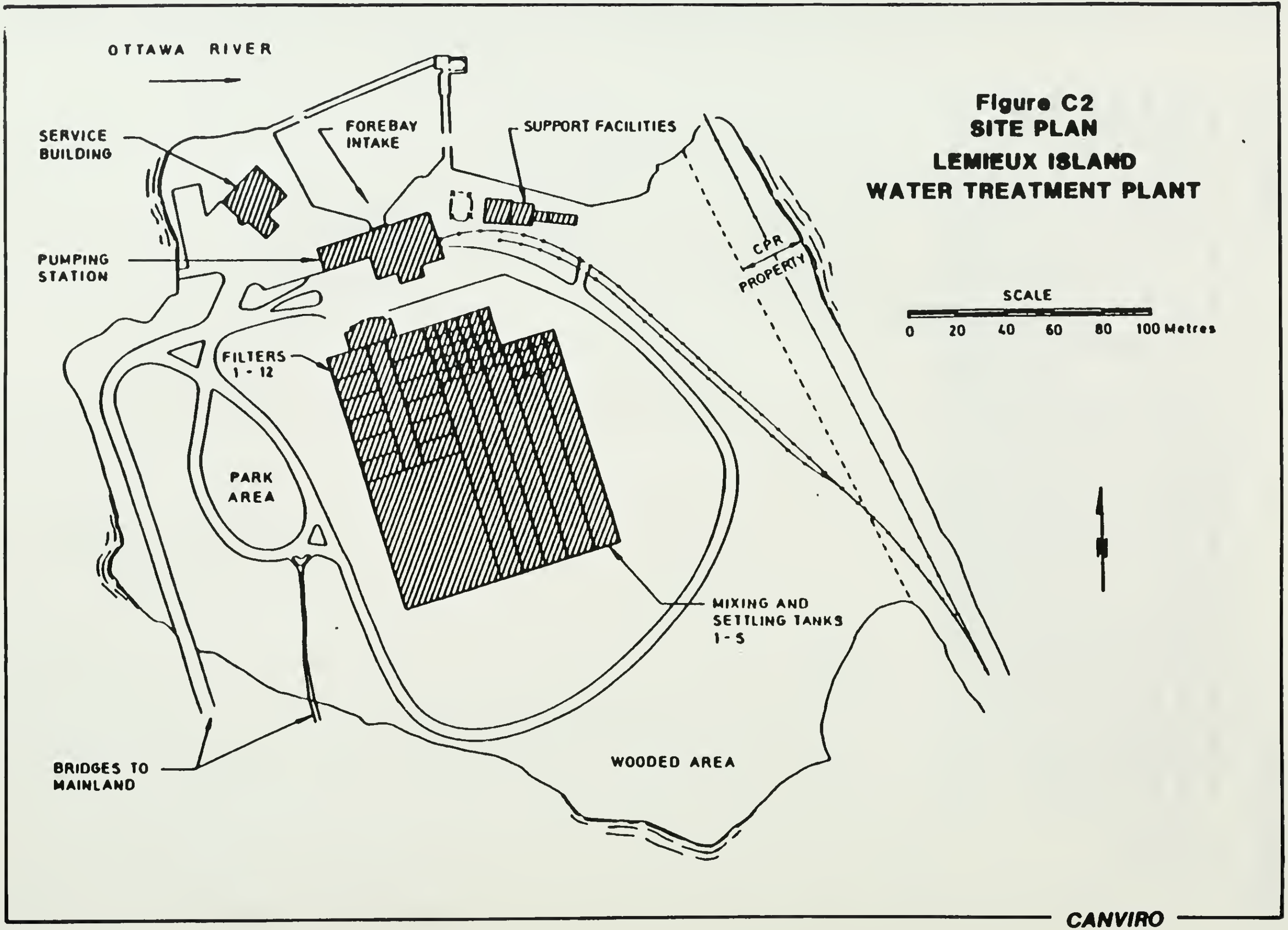


Figure C2
SITE PLAN
LEMIEUX ISLAND
WATER TREATMENT PLANT

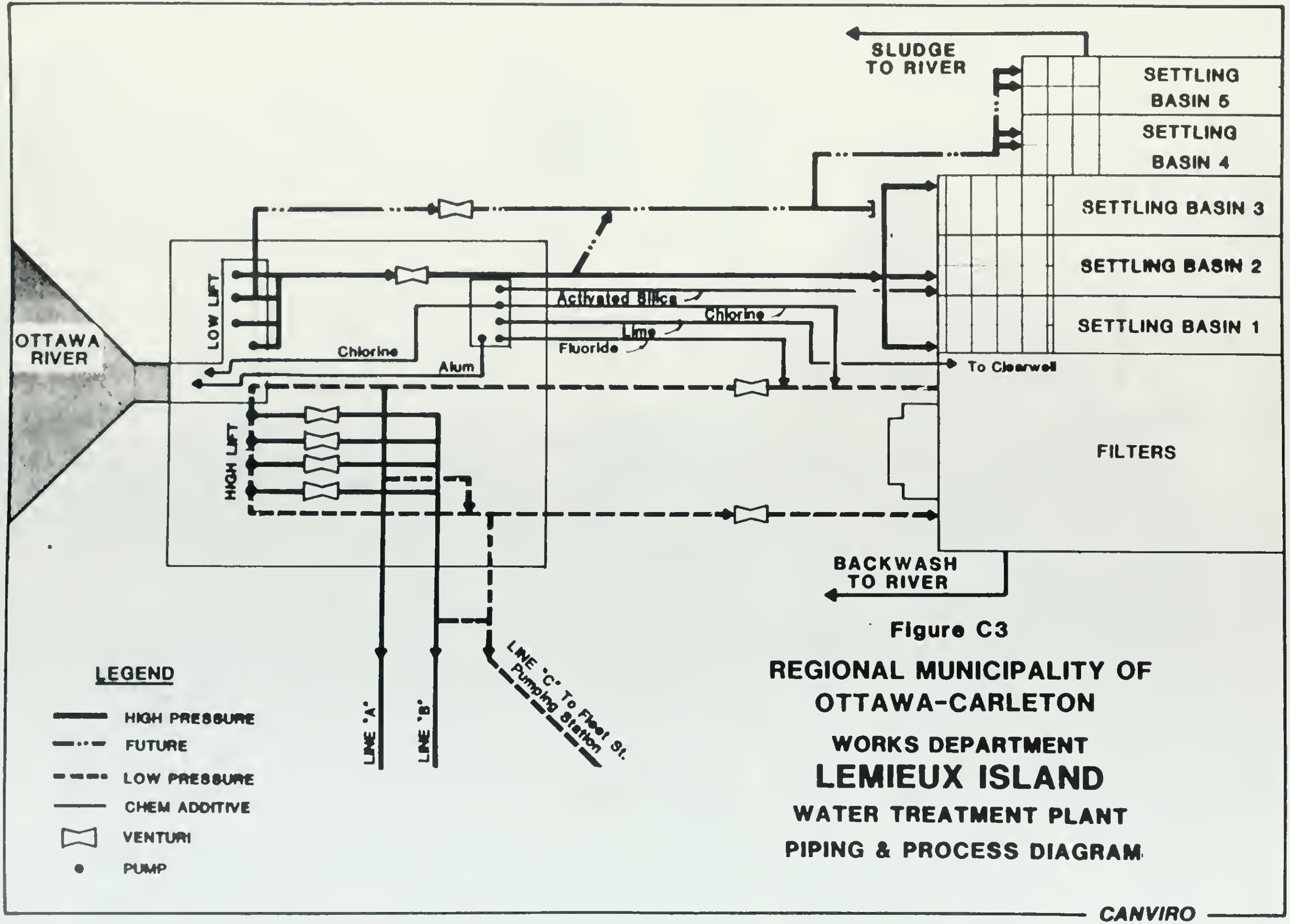


Figure C3
REGIONAL MUNICIPALITY OF OTTAWA-CARLETON
WORKS DEPARTMENT
LEMIEUX ISLAND
WATER TREATMENT PLANT
PIPING & PROCESS DIAGRAM

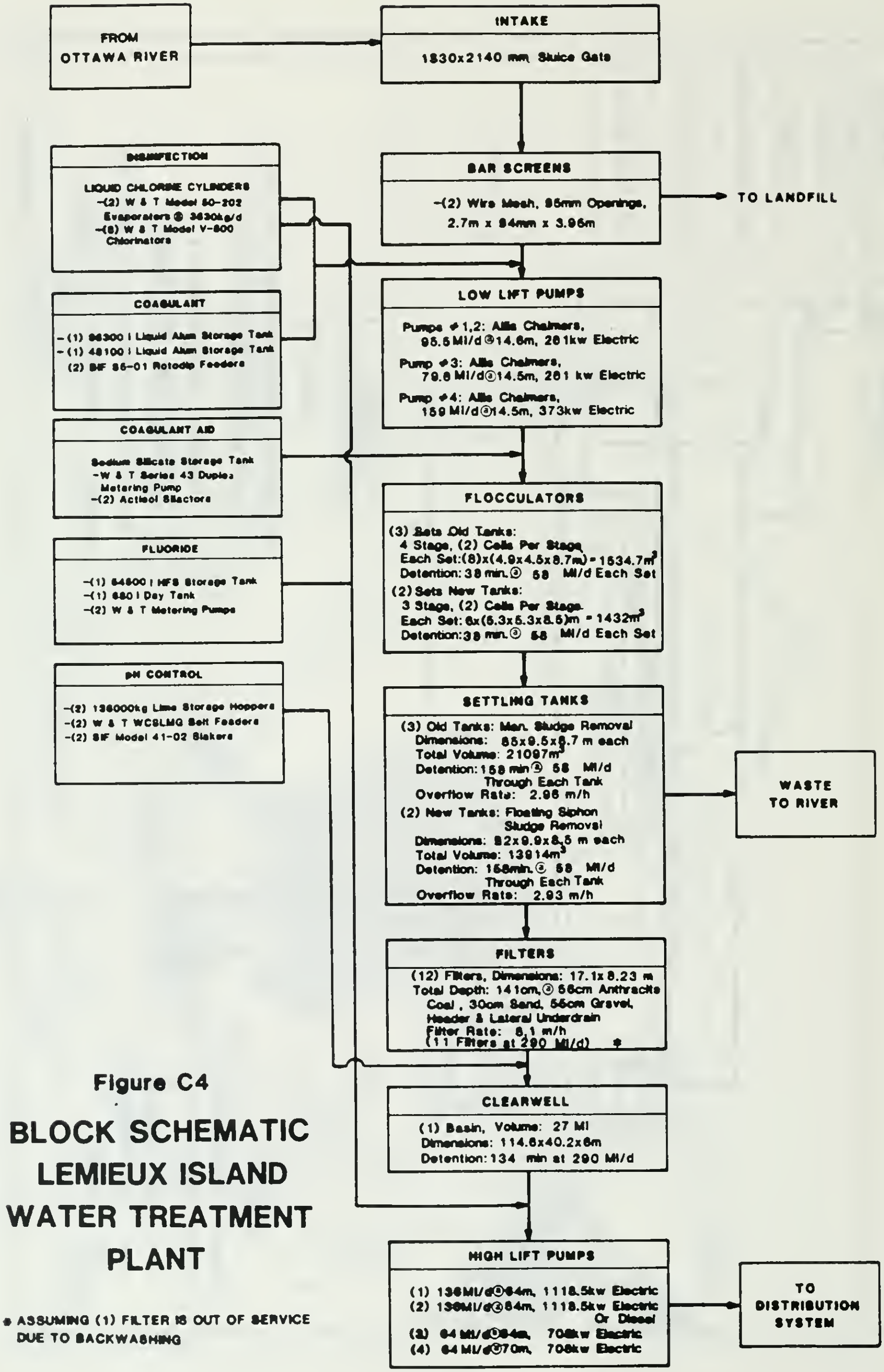


Figure C4

BLOCK SCHEMATIC
LEMIEUX ISLAND
WATER TREATMENT
PLANT

Plate 1:
RAW WATER INTAKE (above)

Plate 2:
ONE OF THE HIGH LIFT
SUCTION LINES

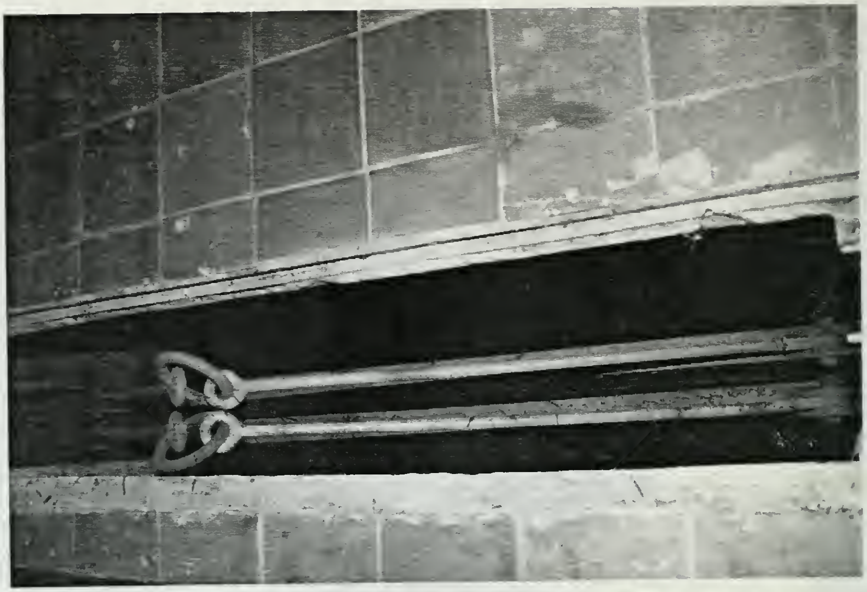


Plate 3:
WIRE MESH (above)
SCREENS

Plate 4:
ALUM ROTO DIPPERS
(exterior) (right)

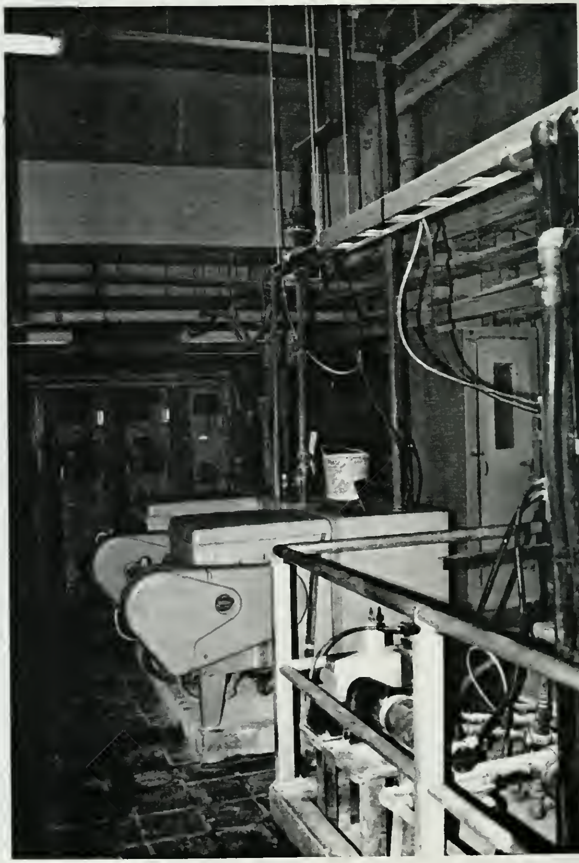


Plate 5:
ALUM ROTO DIPPERS
(interior) (right)

Plate 6:
CHLORINE STORAGE TANKS (below)

Plate 7:
CHLORINE EVAPORATOR
(right)

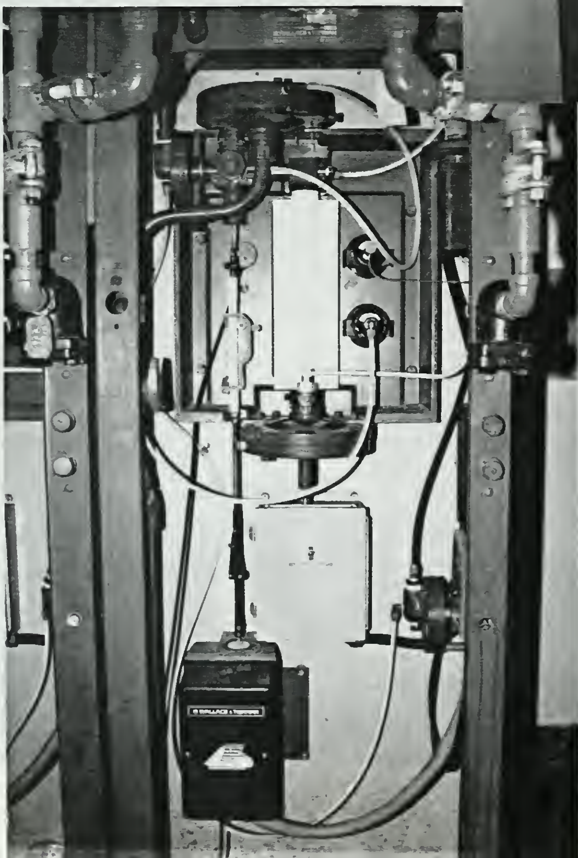


Plate 8:
V-NOTCH CHLORINATOR
(interior) (left)

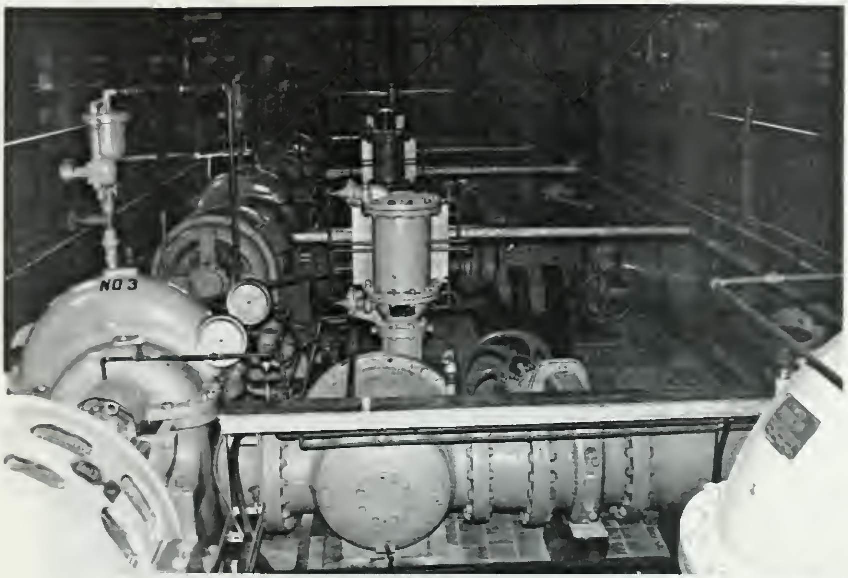


Plate 9:
LOW LIFT PUMPS (above)

Plate 10:
SILICA STORAGE
TANK (right)

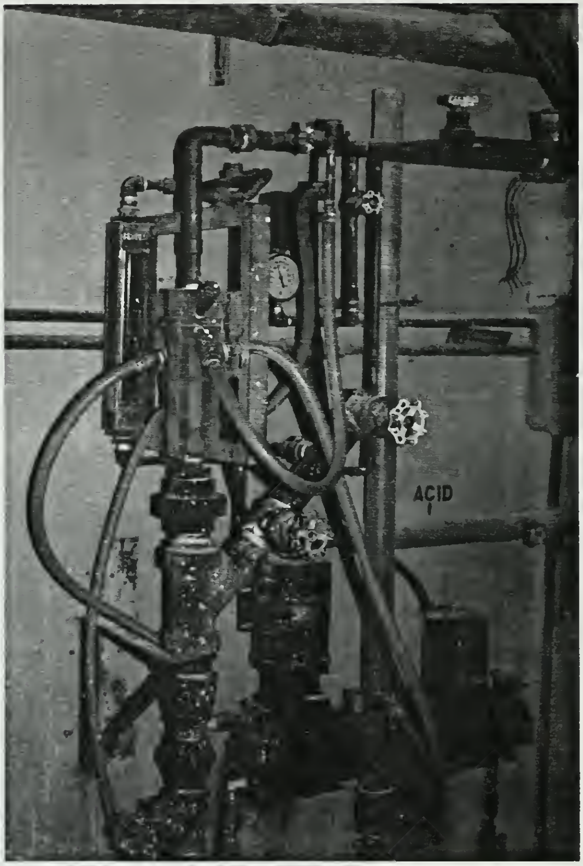


Plate 11:
SILACTOR

Plate 12:
STILLWELLS (SILICA ADDITION POINT)

Plate 13:
SPIRAL FLOW FLOCCULATORS

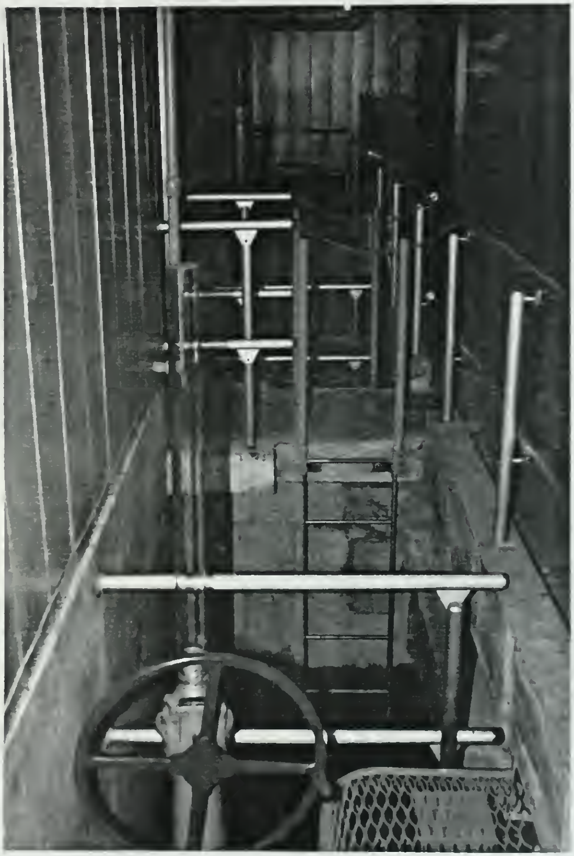


Plate 14:
SETTLING TANKS

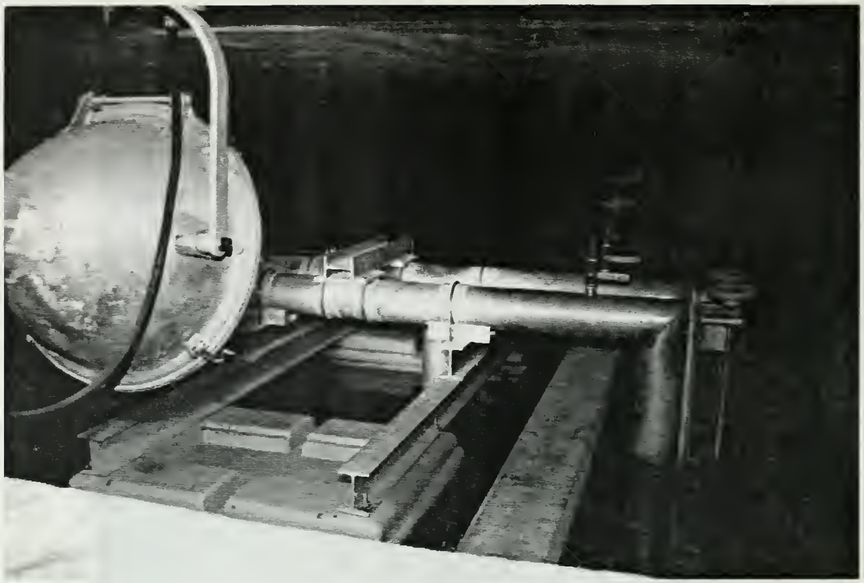


Plate 15:
CLARI-VAC IN SETTLING TANK

Plate 16:
FILTER GALLERY

Plate 17:
INFLUENT VALVES
TO FILTER BEDS
(right)

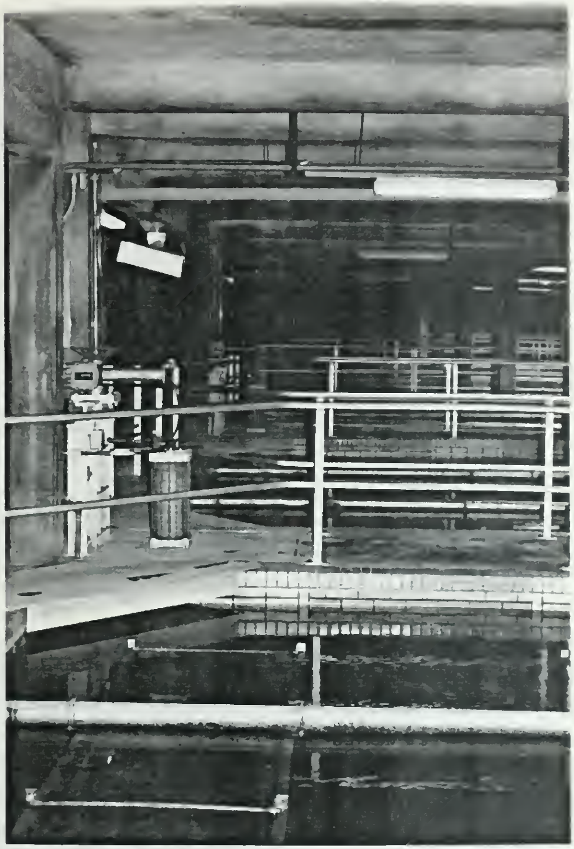
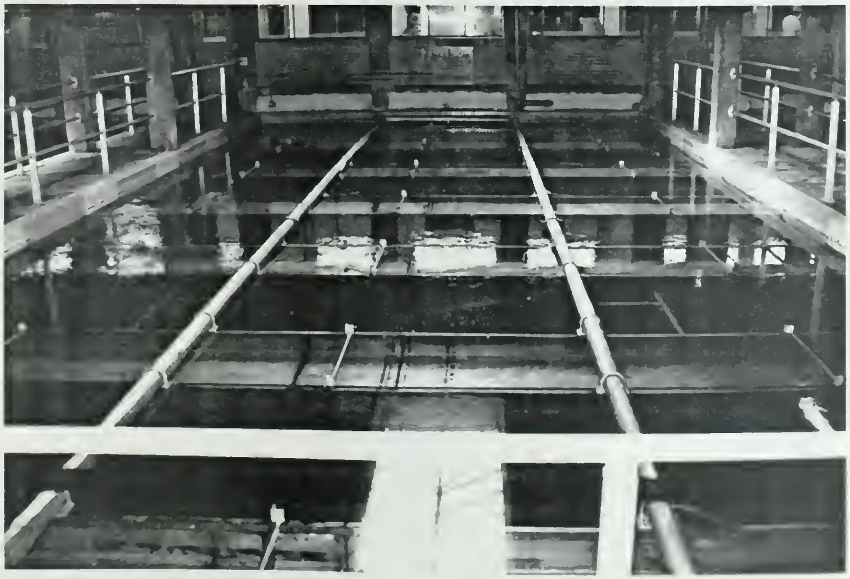


Plate 18:
FILTER BEDS (below)



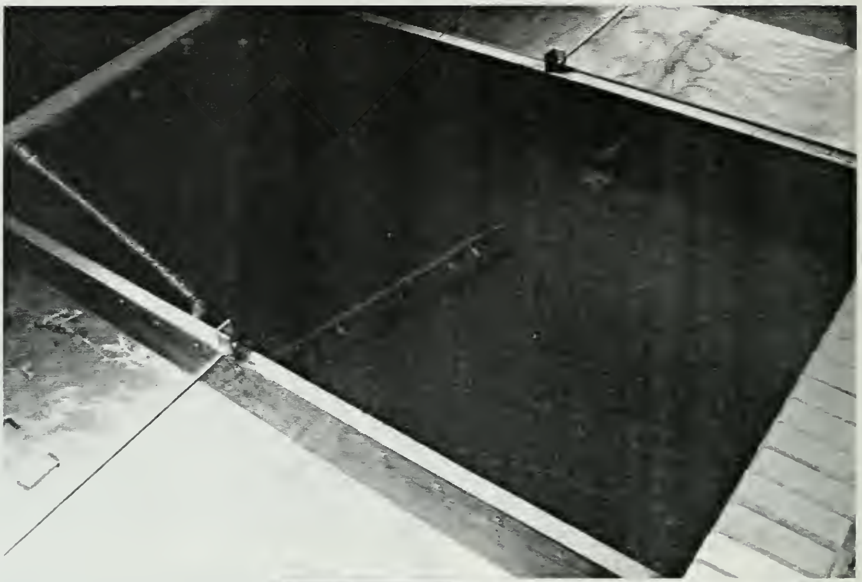


Plate 19:
SURFACE WASH ON FILTER BED

Plate 20:
FILTER EFFLUENT LINE AND LIME FEED POINT (right)

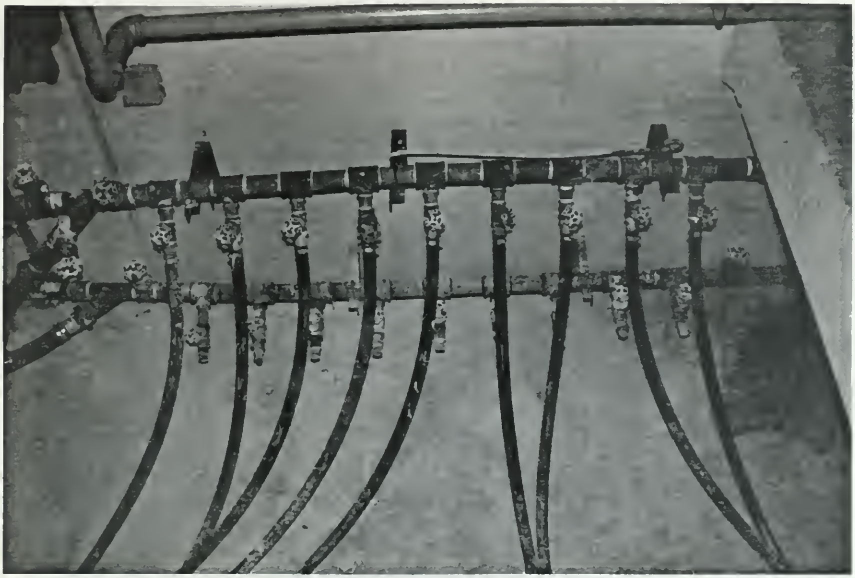


Plate 21:
LIME FEED LINES (above)

Plate 22:
DRY LIME TRANSFER
BLOWER (right)

Plate 23:
TOP OF LIME STORAGE HOPPER (above)

Plate 24:
LIME FEED FROM HOPPER TO SLAKER

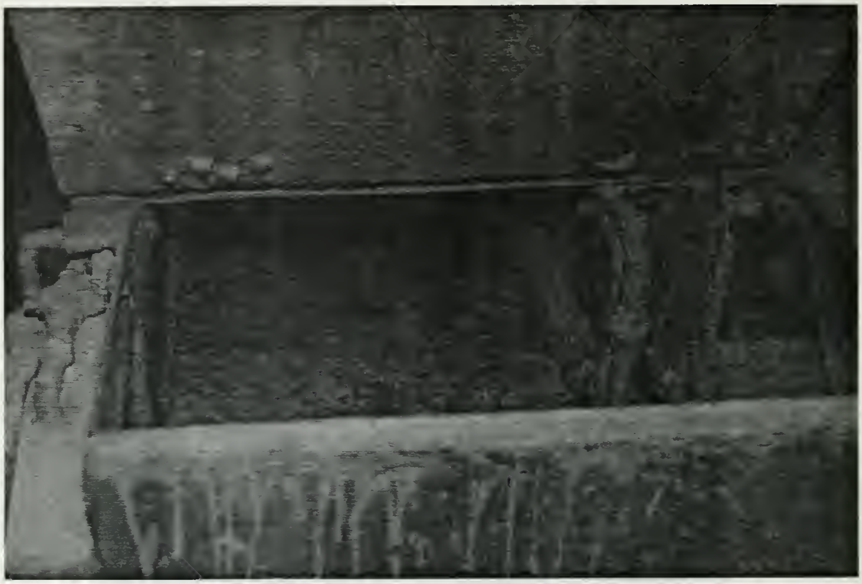
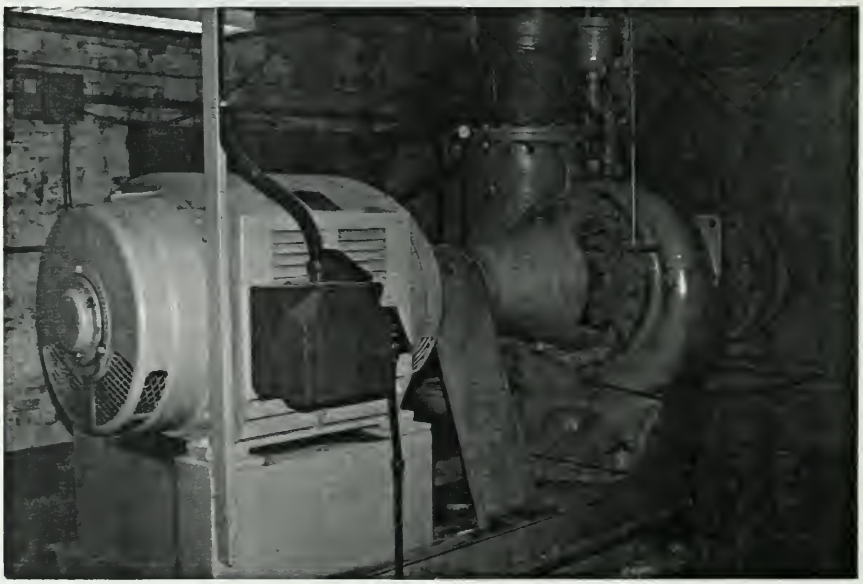


Plate 25:
LIME SLAKER (interior)

Plate 26:
BACKWASH PUMP



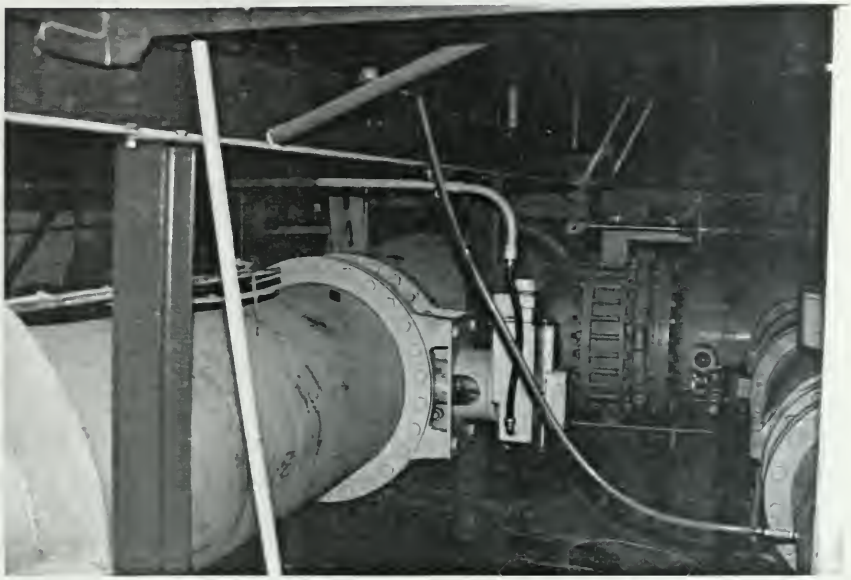


Plate 27:
MAIN BACKWASH FEED LINE

Plate 28:
BACKWASH BUTTERFLY VALVE

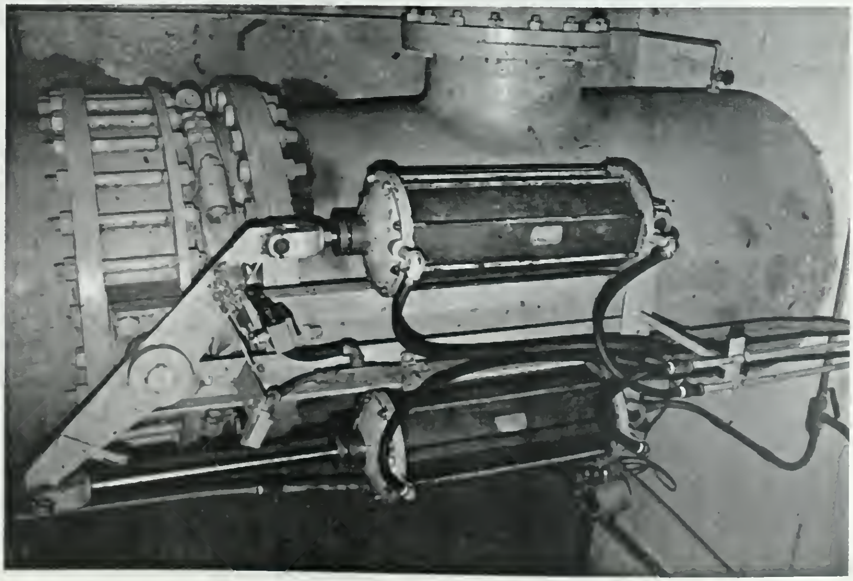


Plate 29:
TURBIDITY METERS (above)

Plate 30:
TURBIDIMETERS (right)

Plate 31:
SAMPLING POINTS (In Lab)

Plate 32:
HYDROFLUOSILICIC ACID STORAGE

Plate 33:
HYDROFLUOSILICIC
ACID STORAGE
TANK (right)

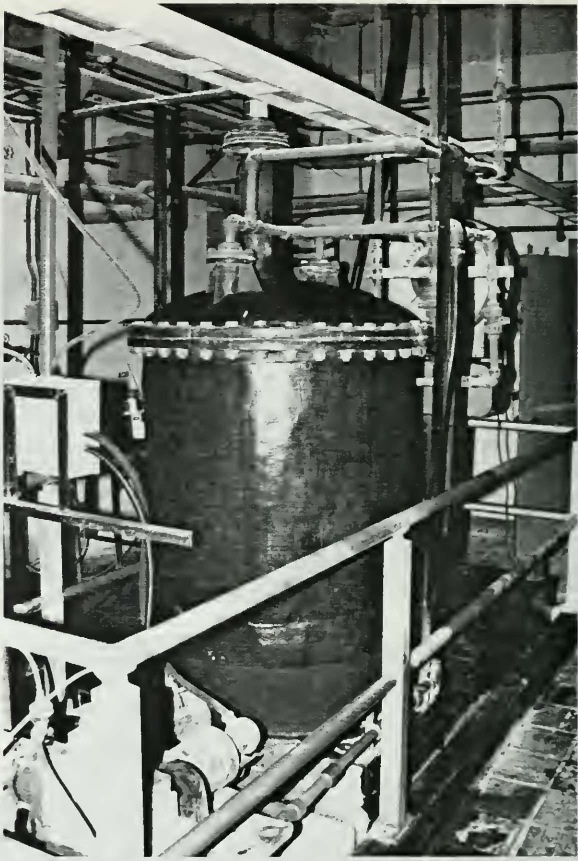
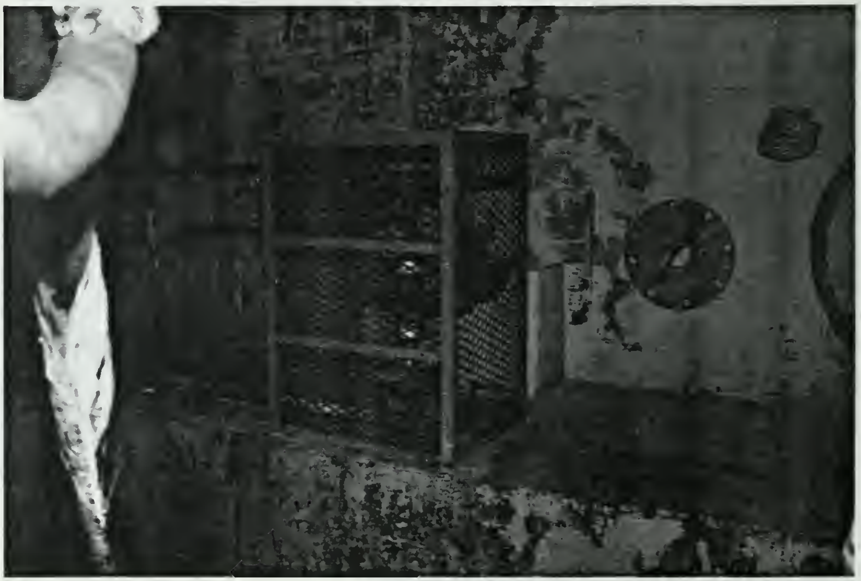


Plate 34:
HYDROFLUOSILICIC ACID
FEED POINT (below)



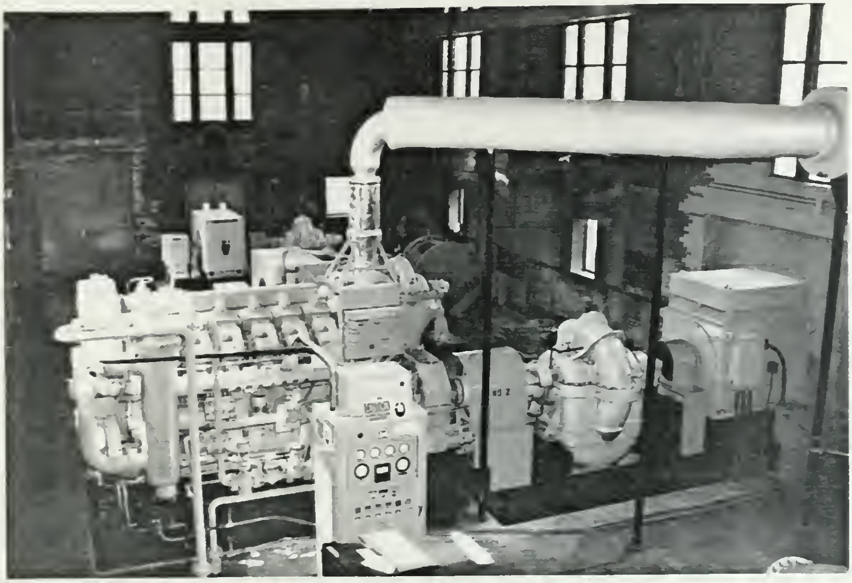
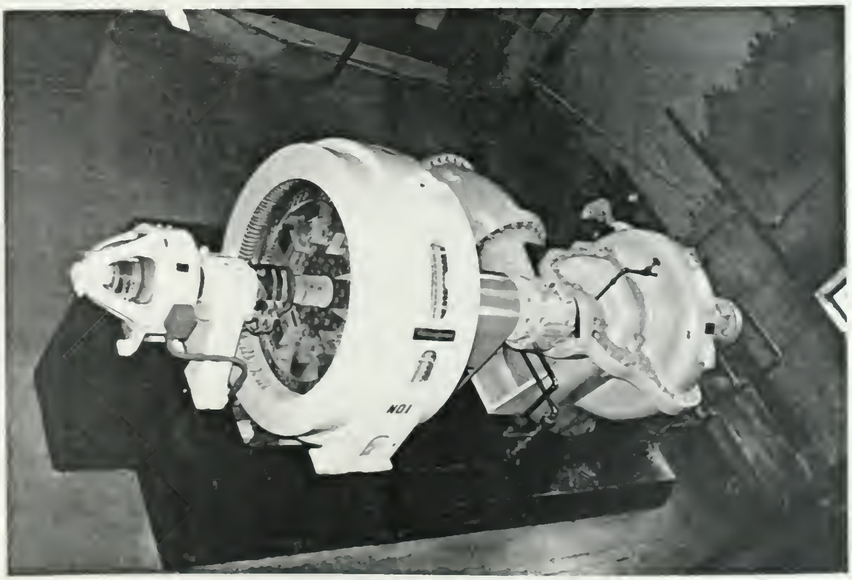


Plate 35:
DIESEL DRIVEN HIGH LIFT PUMP

Plate 36:
ELECTRICALLY DRIVEN HIGH LIFT PUMP



C.9 References

C-1 Ontario Ministry of the Environment. Guidelines for the Design of Water Treatment Plants and Sewage Treatment Plants. Toronto, Ontario, 1982.

D. PLANT OPERATION

D.1 General Description

The Lemieux Island Water Treatment Plant is a continuously operated constant rate facility. Construction of the plant was completed in 1932. At this time the rated capacity was 160 ML/d. In 1978 the plant filters were converted to dual-media (sand and anthracite). As well, two sets of mixing and settling tanks were added increasing the plant rated capacity to 290 ML/d.

The Lemieux plant services the Central Area containing pressure zones 1W, 1E, 2E and 2C.

An analysis of 1983 maximum day demand requirements abstracted from the Region's 1985 Master Planning Study is presented in Figure D1.

The Regional Municipality of Ottawa-Carleton operates the Lemieux Island Water Treatment Plant through the Water Supply Division. The Water Supply Division consists of three branches:

1. Quality Control Branch
2. Operations Branch
3. Maintenance and Construction Branch

The Quality Control Branch is divided into two sections; the distribution system sampling section and the laboratories section.

The Operations Branch is divided into three sections each headed by a plant superintendent. At Lemieux the plant superintendant heads four operating crews rotating through

twelve hour shifts. A crew consists of a shift supervisor, three plant operators (a chemical operator, a filter operator and Fleet St. High Lift Pump Operator) and one floater. The other two sections include the Britannia Operations Section and the System Operations Section.

The Maintenance and Construction Branch is divided into the Electrical and Instrumentation Section, the Mechanical and Structural Section and the Technical Support Section.

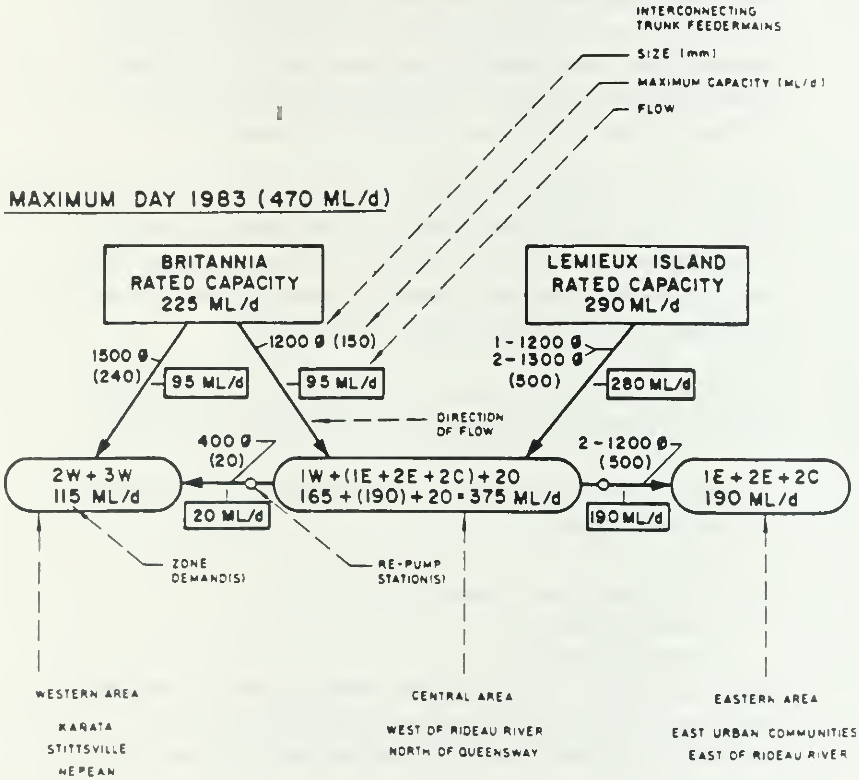


Figure D1

DISTRIBUTION SYSTEM SCHEMATIC

(Source: RMOC Masterplan, 1985)

CANVIRO

D.2 Flow Control

The following is a concise overview of the flow control through the plant.

1. The flow required from Lemieux Island is set by the System Operator given the various high-lift pumping combinations available at the plant and at the Fleet Street pumping station. This decision is based on system storage levels and historical demands.

2. Based on the system operator's plan, the Shift Supervisor at the plant then sets the required combination of high-lift and low-lift pumps. Currently, all pumps are fixed speed and the number of combinations giving a balanced flow through the plant is limited.

3. The responsibility to start and stop any low lift or high lift pump rests solely with the Shift Supervisor.

4. All pumps are monitored from the control room adjacent to the pump house.

5. Pumps will shut down immediately under:
   - Power failure
   - Thermal overload

   There currently is only a low level alarm in the low lift pump suction well and the pumps have to be manually shut down when the suction well is low.

6. Filter flowrates are then set (either together or individually) to produce the appropriate amount of water. Low-lift pumps are throttled on the main discharge line by a valve utilizing a feedback from the water level in the settled water duct. Water level is measured by a BIF 25306 Type 20 openchannel ultrasonic

level meter. The clearwell has a high-level override which is a BIF Model 25302 Type 195 which will send a signal to close the filter effluent valves if it becomes too full. Details of filter operation can be found in Section D.4.

D.3 Disinfection Practices

Gas chlorination is employed at the Lemieux Island Water Treatment Plant for both pre-chlorination and post-chlorination. Chlorine water is injected prior to the low lift pumps for the pre-chlorination step. Average monthly dosages for the three year period 1984 to 1986 are presented in Table 3.0 while monthly disinfection data characteristic of seasonal variations are presented in Tables 3.1 to 3.3 for the years 1986, 1985 and 1984 respectively.

Pre-chlorination dosage requirements are determined by plant staff utilizing a daily grab sample of filter influent taken at a standard location. It should be noted that the pre-chlorination residual measurements recorded in the plant log are taken from the in-plant sample tap which draws effluent from the filters effluent ducts prior to lime addition. In the period 1984 to 1986 residuals typically ranged between 0.06 to 0.37 mg/L total residual chlorine (TRC). Dosages necessary to achieve the above residuals were typically 1.0 mg/L in the months January to April increasing to between 2.0 to 3.0 mg/L in the warm weather months. The warm weather dosage requirements reflect the increased warm weather chlorine demand of the raw water.

Free, combined and total residual chlorine measurement are also performed by Quality Control staff daily on samples taken at the head of the flocculators. These results are presented in Tables 3.1 to 3.3. Chlorine demands between the head of the flocculators and the filter effluent ranged between 0.09 and 0.20 mg/L in the winter months and 0.40 to 0.60 mg/L in the summer months.

In the post-disinfection step chlorine water is fed to the suction side of the high lift pumps. Total chlorine residual is monitored continuously via an on-line Kent Model 1977 analyzer. The analyzer sample stream is withdrawn via a 12.7 mm (½ inch) copper pipe from the high lift pump discharge header.

During the period of 1984 to 1985 and the first half of 1986 a target total residual of approximately 0.9 mg/L was maintained. The required dosage was generally on the same order of magnitude (plus or minus depending on the residual remaining from pre-disinfection chlorination). In the later part of 1986 (August to December) the post-disinfection dosage was increased to 1.4 mg/L total residual chlorine due to distribution system microbiological problems.

All chlorine feedrates are manually controlled based on the required residual and plant flowrate.

D.4 Plant Operation

As previously noted, Ottawa River water enters the suction well of the pump house extension through a port 2 m below water level.

D.4.1 Intake

Once per year the intake well is drained, cleaned and inspected by divers. The screens experience occasional operating problems due to clogging with debris and with frazil ice in winter periods. The change in the intake scheduled for 1991 should alleviate this problem.

D.4.2 Screening

The Lemieux Island WTP is provided with two sets of manual screens. Wastes generated from screening operations are removed to waste containers while any water associated with screenings is discharged to the Ottawa River.

D.4.3 Low Lift Pumps

Screened water is drawn from the low lift pump section well by four (4) low lift pumps. Details of pump specifications can be found in Section C.3 (c).

The combination of low lift pumps needed at a given time is determined by the Shift Supervisor based on the high lift pump combination needed to provide the plant flow required by the System Operator. This required flow is based on historical demand (time of day, time of year) and levels in the storage system. Low lift pumps are throttled on the main discharge line by a butterfly valve utilizing a feedback signal from the water level in the settle water duct. Details of flow control are presented in Section D.2.

D.4.4 Flash Mixing and Flocculation

At the Lemieux Island WTP there is no flash mixing process. Alum and pre-chlorine are added approximately 10 m before the low lift pumps.

The flocculation process occurs in two sections of concrete flocculation tanks. The old section consists of three sets of four stage (2 cells per stage) tanks and the new section contains two sets of three stage (2 cells per stage) tanks. It was found that velocity gradients were barely within MOE guideline values of 60 to 10 s^{-1} during peak summer flows. At other times of the year the values were significantly lower. In general the Gt products were much lower than those reported for other spiral flow flocculators.

G is a root inverse function of liquid viscosity and root function of the specific weight. The raw water temperature range at Lemieux Island Water Treatment Plant typically is in the order of 0.0 to 24°C for winter and summer, respectively. Therefore, between the seasonal extremes in water temperature, the G can be decreased by 29% in the winter from water temperature alone. If flowrates cannot be increased, the performance of the flocculator cannot be altered. The problem can be further exacerbated in the winter since this season typically has the lowest water flow in the plant.

The evidence provided in Appendix A, Table 2.1, for January and July 1986 support the hypothesis that the flocculators may be performing poorly during the winter months. The mean turbidity of the settled water in January was 1.9 NTU whereas the mean turbidity of the settled water in July was 0.9 NTU, 54% lower than in winter. Also, if one compares raw water turbidity in January with the settled water turbidity, it is apparent that there is little practical difference. Whereas, in July, there is a difference between

raw water turbidity and settled water turbidity. However, these observations may be confounded by degraded performance of the settling basins since they are operating at the upper limit of acceptable overflow rates.

At Lemieux Island tapered flocculation is not provided, however given the velocity gradients this does not appear to be a deficiency.

The flocculators are generally drained and inspected at 8 to 12 week intervals in conjunction with the settling basin cleaning program.

D.4.5 Sedimentation

Each set of flocculators (old and new) discharge into a settling basin. The old settling basins are manually cleaned at approximately 8 to 12 week intervals. The new settling basins contain automatic floating siphon sludge removal mechanisms. The waste generated is discharged directly to the Ottawa River.

Generally, the performance of these sedimentation tanks is robust with respect to raw water quality and flow variation. Typically 80 to 90% of the coagulated particles are removed. This is mainly attributed to the considerable length of the tanks. However, the performance of rectangular, horizontal flow settling tanks is dependent upon sufficient retention time and adequate overflow rates under cold water conditions. As will be shown in Section E, the settled water turbidity in the winter is not significantly different from the raw water. It is not clear if this results from inadequacies in the flocculators or in the settling basins. However, qualitative evidence from the operators at Lemieux Island Water Treatment Plant indicates that less sludge accumulates in the winter then in the summer suggesting

poorer clarifier performance. This may however be the result of smaller floc size. Therefore, no firm conclusions can be drawn as to the cause(s) of degraded settling basin winter performance.

D.4.6 Filter Operation

The filters operate in two ways - filtering and backwashing. The following section describes the procedures connected with filter control and backwashing. These procedures will form the basis for future computer process control.

Filtering

The filters are nominally operated in a constant rate mode. However, when the level of the water in the clearwell is within the top 3.3 m control band, the position of the filter effluent valve is automatically controlled through a local field system. In this "level over-ride proportional" control mode, changes in clearwell level cause the filter effluent valve to open and close.

When the level in the clearwell falls below this control band level, the filter effluent rate valve position is controlled by the filtration rate set-point. In this mode, the filter will have either an individual set-point or be under "master computer auto rate control" where the same set-point is received by all the filters deemed to be in service by the operator.

If the water level in the filters falls below a pre-set "low level" (level probe contacts), the effluent rate control valve closes. The level must return to a slightly higher pre-set "restart level" (second level probe contact) before resuming filtering. This ensures that the filter is continuously submerged.

Backwashing

The backwash sequence for the Lemieux Island WTP is depicted in Figure D2. Details of the sequence are presented in point form in the following:

1) The backwash sequence is initiated when there is an effluent turbidity breakthrough of 0.5 FTU or 1.5 m headloss in the filter. A typical filter run is 48 hours. Thus approximately 6 filters are washed per day.

2) The actual backwash procedure is initiated by the closing of the filter effluent valve. Simultaneously, the filtered water turbidity sample solenoid closes and at this point the filter is not incorporated in the effluent turbidity scan cycle. The scan cycle consists of the turbidity measurement of three filter effluents at any given time. This changes once per hour. The closure of the filter effluent valve is confirmed by zero flow registered on the filter flowmeter.

3) The filter influent gate is closed. The backwash sequence will have a variable pause at this point to allow escape of entrapped air. The length of this pause varies with the season. Generally it is greatest in the spring due to high dissolved oxygen levels where the required pause length may reach 30 minutes.

4) The main filter wash-water supply valve is now opened as well as the surface wash agitator valve.

5) The lead wash-water pump is started and the wash-water control valve opens to a position equivalent to "low rate" which is approximately 45 ML/d.

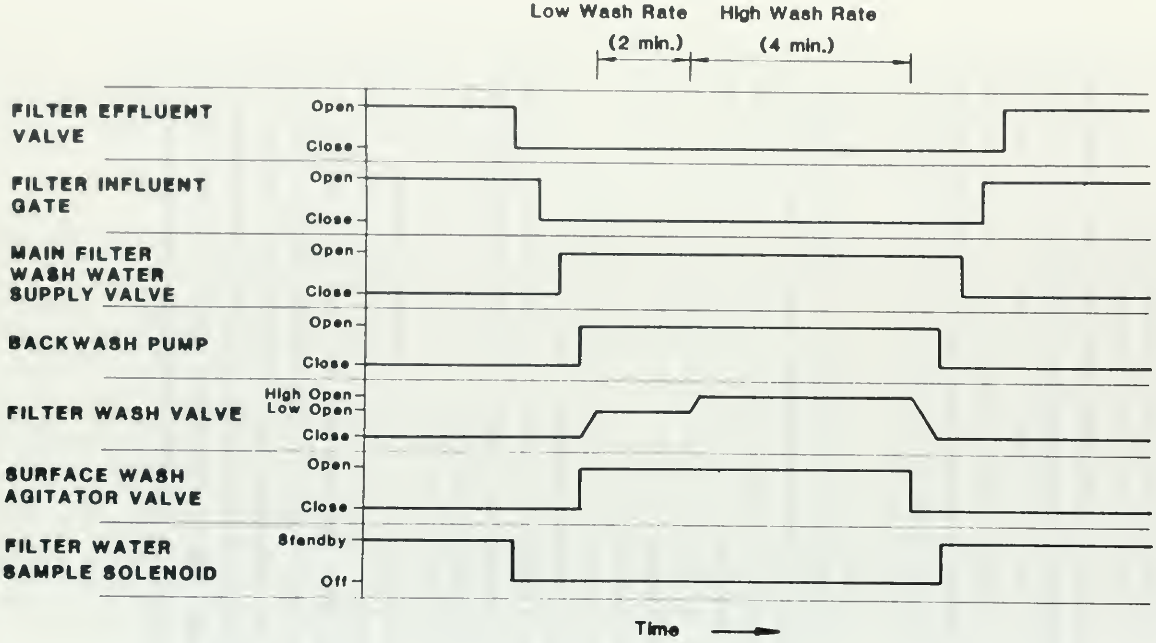


Figure D2

FILTER WASH CYCLE FOR LEMIEUX

CANVIRO

6) The initial low rate wash is carried out for two minutes. It is used to acclimatize the filter to the backwash water and allow even bed expansion. It also allows the surface agitators to get up to speed. At this point the wash-water control valve opens completely. The wash-water rate control valve is opened to produce the flow required for high rate wash. This corresponds to approximately 118 ML/d.

7) The high rate wash is maintained for four minutes. Bed expansion at this point is approximately 150 to 200 mm. All wash water is discharged directly to the Ottawa River.

8) Following the high rate wash period, surface agitation ceases with the closure of surface wash agitator valve. The wash-water control valve is slowly throttled to the closed position.

9) The backwash sequence is now completed with the following control actions:
   - closure main filter wash-water supply valve
   - opening of filter effluent gate
   - opening of filter effluent control valve
   - positioning of the filtered water sample solenoid to the stand-by position

10) After backwashing the filter is brought on-line immediately and no filtering to waste is allowed. Each backwash consumes approximately 450 m^3 of treated water. This corresponds to approximately 3.2 m^3/m^2 per wash which is considered low. However, no problems such as mudballing or increase in clean bed headloss have been observed in connection with filter operation suggesting that the backwash procedure is adequate.

D.4.7 Clearwell

Cleaning of the clearwell occurs approximately every year using divers. This is required due to settling of lime fines on the bottom of the clearwell.

D.4.8 Water Stabilization

Lime is added to the filter effluent in order to reduce the aggressiveness of the finished water. However, problems with elevated treated water turbidities were experienced in 1986 due to the appearance of insoluble lime impurities in the plant effluent. This occurred even though most of the insoluble fraction of the slaked lime settles out in the clearwell prior to entry into the distribution system. Reduction of lime addition may not be possible since the pH at $CaCo_3$ saturation is calculated to be between 8.75 and 9.10 depending on water temperature, calcium concentration and alkalinity of the finished water. Therefore, a finished water pH of 8.0 will have a negative Langelier index of 0.75 to 1.1 which means that the water will still be mildly aggressive at current dosages. It should be noted that a pH of 8.0 is not consistent with optimum disinfection practices.

The Regional Municipality of Ottawa-Carleton Water Treatment Master Plant (Ref. E.5) contains a discussion of this problem and two potential solutions. The first solution involved the degritting of the lime. Currently, Quality Control staff are evaluating the effectiveness of a lime saturator which produces a clear lime water at a concentration of about 1.5%.

The RMOC Master Plant also suggested an additional alternative; the introduction of limestone ($CaCO_3$) into the water prior to or in conjunction with alum coagulation. This provides additional alkalinity and hardness for aggressiveness control without altering the raw water pH. The limestone can also provide additional surface areas which could aid flocculation.

D.5 Chemicals

Chemical dosing requirements are determined by the Quality Control Branch based on a number of variables including: season, plant flowrate; and raw water quality.

Alum is used not only for coagulation but also for pH adjustment of the raw water. Its dosage is based primarily on the amount required to reduce the raw water pH to 5.5 to 6.0 for effective colour removal. Typically a dosage of 32 - 34 mg/L will achieve this objective. At Lemieux Island alum feed is flow proportioned and dosage adjustment is manual. Once every half hour the Chemical Operator will check the incoming raw water flowrate and determine the required dosage based on a standard dosage chart developed by the laboratory personnel. The Operator will then record the amount of alum fed during the previous half hour and adjust the feedrate based on any discrepency between the amount that was required and the amount actually fed. Confirmation is made by checking pH levels of the water at the flocculators.

Sodium silicate is used as a coagulant aid once it has been activated with alum. This will occur in one of two Actisol units as described in Section C.4. Activated silica dosage is manually flow proportioned. Presently a dosage of 0.5 mg/L is used as a coagulant aid at plant flows of less than 200 ML/d. For high flows, dosages range from 0.50 mg/L to 1.0 mg/L depending on the achievable length of a filter run. In the winter, the base dosage is 1.5 mg/L and may increase with high pumping rates. It has been found that high activated silica doses cause filter runs to shorten. Silica dosage control is similar to alum dosage control. Once every hour the Chemical Operator will determine the amount of silica required for a given plant flow based on flow/dosage charts and the amount actually being fed and

adjust accordingly. The Operator will also ensure that the activated silica pH is between 5.5-5.8 to prevent line blockage.

A fluoride ion concentration of 1.0 mg/L is desired in all finished water, year-round. The dosing rate is manually adjusted and the feed rate is automatically paced with the plant effluent flowrate. Residual analysis is performed by a Technicon Monitor II Analyzer. The sampling system draws a sample from the discharge side of the high-lift pumps and is designed to provide a lag-time of 8 to 10 min. between injection and detection.

Chlorine dosing is based on the demand and desired residual at both the pre- and post-chlorination points. A chlorine residual of 0.8 to 1.1 mg/L total chlorine in the plant effluent is usually required to meet the disinfection requirements in the distribution system. Chlorine residuals are determined by continuous total residual chlorine analyzers.

Lime is added to the filter effluent in order to reduce the aggressivness of the filtered water. A pH greater than 8.0 is maintained by dosing the lime slurry based on the pH of the plant effluent.

Maintenance and calibration of the above mentioned instruments are described in Section D.6.

D.6 Sampling and Data Collection

Table D.6.1 summarizes the in-plant monitoring program. The plant lab contains three sample taps. Raw water is taken 10 m upstream of the low lift pumps and transferred through 19 mm copper tubing to the lab. Filtered effluent water is sampled from the filter effluent line prior to lime addition. The lab tap is cycled between filters through the use of a selection solenoid as chosen by the filter operator. Plant effluent is sampled on the discharge side of the high lift headers and is transferred through a 19 mm copper tubing to the lab. Grab samples are also taken at the filter head and influent to the flocculators to evaluate chlorine dosage and residual and monitor turbidities. Additional time weighted composite samples of raw and finished water are taken for daily and weekly analysis.

The pH sample line from the low-lift pumps is flushed on a monthly basis.

Calibration of the residual fluoride analyzer and all pH meters occurs every day. The residual chlorine analyzer and recorder is also calibrated every day or more if required. The turbidimeters are calibrated once per week or as required. Both the zero and span are checked. Maintenance and cleaning of all instruments occurs once per week except for the fluoride residual analyzer which occurs on an as needed basis.

Table D.6.1

LEMIEUX ISLAND - IN-PLANT MONITORING

Test	Sample Point	Frequency	Testing Instrument
Free Chlorine Residual	Plant Effluent - lab tap	Daily	Penwalt Amperometric Titrator
	Filter Influent - grab	Daily	Penwalt Amperometric Titrator
	Filter Effluent - lab tap	Daily	Penwalt Amperometric Titrator
	Mixing Chambers - grab	Daily	Penwalt Amperometric Titrator
Fluoride	Raw - composite	Weekly	Orion SIM
	Plant Effluent - online	Continuous	Specific Ion Series 81-02
	Plant Effluent - lab tap (composite)	Daily	Orion SIM
pH	Plant Effluent - lab tap	Daily Hourly	Fisher Accumet (325) Colour Comparator
	Low Lift Header CL2 Add.	Continuous	Foxboro-2220 (2)
	Filtered Water - lab tap	Daily	Fisher Accumet (325) Lisle-Metrix
	Raw - lab tap	Daily	Fisher Accumet (325)
	Plant Effluent - online	Continuous	Foxboro-2220 (2) Beckman Model 900

Table D.6.1 (cont'd)

LEMIEUX ISLAND - IN-PLANT MONITORING cont'd

Test	Sample Point	Frequency	Testing Instrument
Silica	Raw (composite)	Weekly	LKB Ultra Spec
	Treated Water - composite	Weekly	LKB Ultra Spec
Turbidity	Treated - lab tap	Hourly	Hach Ratio
	Filtered Water - lab tap	Daily	Hach Ratio
	Filter Effluent	8/day	Hach Model 1720B
	Raw Intake - lab tap	Daily	Hach Ratio
	Filter Influent	Continuous	Hach Model 1720B
	Plant Effluent	Continuous	Hach Model 1720B
	Filtered Influent	Daily	Hach Ratio
Residual Aluminum	Plant Effluent - grab	Weekly	LKB Ultra Spec.
Total Chlorine	Filter Effluent - lab tap	Daily	Penwalt Amperometric Titration
	Mixing Chamber	Daily	Penwalt Amperometric Titration
	Plant Effluent - online	Hourly Continuous	Wallace and Tiernan

D.7 Other Water Quality Concerns

Concern for the organic content of water and its combination with chlorine has resulted in the routine use of surrogate parameters for monitoring of organics such as Total Organic Carbon (TOC), such as ultraviolet and infrared spectroscopy. Many water plants in Canada, United States and Europe routinely or continuously monitor these surrogate parameters.

No data exists at Lemieux regarding ultraviolet absorbance (UVA) on either raw or treated water. TOC analyses were initiated at the Lemieux WTP in 1986. On-line monitoring of UVA can provide advance warning of increasing organic concentrations, enabling the operators to adjust chemical feed rates. It was of interest to establish a relationship between TOC and trihalomethane formation potential (THMFP).

Total aluminum levels in treated water have generally been below 100 µg/L as Al although levels as high as 650 µg/L as Al have been recorded. Soluble aluminum is mainly a result of using alum as a coagulant.

Aluminum residuals in the Lemieux WTP water are minimized through the use of silica as a coagulant aid and the increase of the pH by lime in the treated water.

D.8 Process Automation

Currently, Lemieux Island is undergoing conversion to the Supervisory Control and Data Aquisition (SCADA) System. Initially this will be used for detailed data logging of plant status and will also allow for manual control of most plant operations from a central point. This is due to become operational by the spring of 1989. Eventually the capability of the system will allow the inclusion of control programs that will automatically perform such functions as backwashing and varying chemical dosages.

D.9 Daily Operator Duties

At the Lemieux Island Water Treatment Plant each shift consists of a Shift Supervisor, one Filter Operator and one Chemical Operator and the Fleet Street Pumping Station Operator.

The Filter Operator is responsible for monitoring filter operation and performing backwash routines. Once every half hour the Filter Operator will record filter effluent turbidity, colour and loss of head. Once every hour the Operator will do the following:

Sample	Tests
flocculator water	pH, alkalinity, chlorine
raw water	turbidity, alkalinity, conductivity, chloride
silica feed	pH

The Chemical Operator is responsible for all chemical systems in the plant. Once every half hour the Operator will walk through the plant and perform the following functions:

- o check to ensure each piece of equipment is functioning properly
- o records feeder rates and recorder values
- o look for problems in the feeders
- o performs a comparison of plant effluent chlorine to recorder indicator to ensure proper recorder function

The Fleet Street Operator is responsible for the operation and performance of the 5 hydraulically turbine driven high lift pumps and related aquaduct operation. Every half hour the operator will record flows, pressures and oil lubricating parameters. Pumps are started and stopped as requested by the Shift Supervisor.

E. PLANT PERFORMANCE (PARTICULATE REMOVAL)

E.1 Turbidity Removal

(a) General

The World Health Organization (Ref. E-1) provided an excellent summary of the history of turbidity as a water quality parameter and the causes of turbidity. The measure of turbidity determined by the degree of light scattering relative to the axis of a light source is given as formazin turbidity units (FTU). Turbidity determined by a turbidimeter which measures light intensity perpendicular to the light axis is presented as nephelometric turbidity units (NTU). Results presented in this study are reported as formazin turbidity units (FTU).

Turbidity can be caused by a wide range of particle types and sizes suspended in the water column. Particles can range from inorganic soil particles and organic vegetable matter to microorganisms, macromolecules and microscopic fibres.

The significance of turbidity as a water quality parameter is related to the following properties:

- protection of microorganisms from the effect of disinfectants
- adsorption of microorganisms
- source of nutrients to some microorganisms
- source of taste and odour problems

- formation of organometallic complexes
- adsorption and concentration of undesirable priority pollutants
- a measure of the performance of liquid-solid separation processes

The principal water treatment processes used for removal of particulate matter are coagulation/flocculation, sedimentation, and filtration. Chemically pretreated surface water followed by well designed and operated rapid sand filters can routinely produce filtered water of less than 0.2 NTU (Ref. E-2).

(b) Treatability Testing

The standard method of assessing the treatability of a surface water for particulate removal is by means of jar testing using the standard Phipps and Bird, Inc., 6-place, paddle-stirring apparatus (Ref. E-4). Occasionally the supernatant is passed through a paper filter or bench-scale sand filter to estimate the overall removal efficiency. However, a more usual objective is minimizing residual turbidity in the settled jars. The method described in Ref. E-4 is one of the best available for jar testing for the following reasons:

- provides rapid estimate of coagulant dose
- allows evaluation of floc strength
- permits calculations of the root-mean-square velocity gradient
- the settling velocity of the floc can be quickly estimated

Currently, jar testing is rarely performed at Lemieux Island since alum dosage is based on the required pH adjustment for optimum colour removal. However, considering the excellent performance of the plant, this is a minor point under existing circumstances.

(c) Plant Performance

The data contained in Table 2 (Appendix A) was summarized for the raw, settled, and filtered water turbidities for the months of January, May, July and October in 1984, 1985 and 1986. The summary is:

Turbidity (FTU)

Date		Raw		Settled		Filtrate		Overall Removal
Year	Month	Mean	Std. Dev.	Mean	Std Dev.	Mean	Std. Dev.	%
1986	January	1.4	0.21	1.9	0.23	0.20	0.061	86
	May	2.5	1.3	1.5	0.25	0.15	0.052	94
	July	1.2	0.20	1.0	0.19	0.15	0.086	88
	October	1.7	0.056	1.1	0.24	0.17	0.070	91
1985	January	2.2	0.12	2.3	0.34	0.17	0.050	98
	May	2.4	0.70	1.3	0.40	0.17	0.040	94
	July	1.3	0.31	1.0	0.34	0.14	0.040	89
	October	1.3	0.41	1.2	0.19	0.13	0.020	89
1984	January	1.3	0.20	2.0	0.30	0.17	0.080	89
	May	2.2	0.81	1.3	0.38	0.16	0.070	93
	July	2.5	1.42	1.5	0.34	0.16	0.08	94
	October	1.9	0.24	1.2	0.20	0.10	0.02	95
Mean		1.8		1.4		0.15		92

In conjunction with the summary of turbidity removals, it is of value to consider the trends in flows through the plant as follows:

	Flow, ML/d		
Year	Minimum	Maximum	Mean
1986	125	287	196
1985	139	316	197
1984	119	298	202
1983	150	314	212

Comparing the settled water and raw water turbidities reveals that problems with the flocculation/sedimentation units is occurring in the winter.

However, as can be seen the plant is consistently capable of producing filtered water with turbidities less than 0.2 FTU which is consistent with well-operated rapid sand filters using adequate pretreatment (Ref. E-3).

The size of the standard deviation for the monthly mean turbidity of the settled water is noticeably larger in May of each year. This suggests that snowmelt from the Ottawa River watershed causes difficulty in maintaining consistent flocculation performance. However, the rapid sand filters do not have a problem achieving filtrate turbidity objectives.

Turbidity removal efficiency for each aspect of plant operation will be discussed in separate sections below.

i) Chemical Type

Presently, alum is used as the primary coagulant and activated silica is used as a coagulant aid. Substitutes for alum have been investigated, however it was found that no performance or economic benefits would result from changing coagulants. Plant staff have investigated the use of ferric chloride and found that it is ineffective for colour removal. The use of polyaluminum chloride (PACl) was investigated in the jar testing phase of this study and found to perform adequately. However it is not as economical as alum.

ii) Flash Mixing

Currently there is no rapid mixing process at Lemieux. Rather, the low lift pumps are relied upon for mixing chlorine, alum and raw water. The expansion of Britannia which will include rapid mixing for alum may demonstrate a significant improvement in flocculation to warrant a similar retrofit of a flash mixing step.

iii) Flocculation

The decrease in performance of the flocculation and sedimentation processes during the winter months (see above) is attributed to both colder water temperatures and smaller flow rates. The low flow conditions result in lower Gt values in the flocculation tanks potentially decreasing the size of floc particles.

One solution could be the removal of one set of flocculation tanks during periods of low plant flow to maintain the velocity gradients necessary for good floc formation. This change could perhaps be investigated during the seasons where flocculation performance is adversely affected by cold water conditions.

iv) Sedimentation

The settling basins may also be partly responsible for decreased performance in terms of high settled water turbidities during the winter months. The clarifier short circuiting observed at Britannia may also be occuring at Lemieux. The specific causes of the short-circuiting are not clear. However, improperly designed inlet and outlet structures and density currents resulting from the cold water are common problems (Ref. E-3).

Plant staff are currently evaluating the effectiveness of plate settlers. It is recommended that this work continue given the problems previously discussed and the rather high overflow rates calculated in Section C.2 (g).

v) Filtration

Generally, the filters operate extremely well at Lemieux Island, consistently providing filtered water turbidities below 0.2 FTU over a wide range of settled water turbidities. Filter runs average 48 hours but may get as high as 72 hours in the winter during low flow conditions. It may be possible to extend filter runs by utilizing coarser media (which may produce poorer quality water). However, given the current performance of the filters this is not necessary.

During certain seasons, notably winter, settled water turbidity approaches that of the raw water. This effectively alters Lemieux from a conventional plant to a direct filtration plant. Normally, this does not create difficulties since direct filtration is an acceptable water treatment technology. However, the multiple-barrier concept is weakened by the loss of clarification and other factors become important.

Concern about removal of organics and reduction of trihalomethanes (THMs) are important. Coagulation, flocculation and sedimentation can reduce the organic content of raw water by up to 60% in some plants reducing THM production and improving disinfection by eliminating demand from non-disinfection organic reactions.

vi) Post-Filtration Turbidity

The addition of insoluble impurities during water stabilization with slaked lime has caused significant turbidities in the finished water. This resulted in the moving of the lime feed from the outlet of the clearwell to the point where the filtered water enters the clearwell. The clearwell acts as a sedimentation basin for the insoluble fraction of the lime.

As discussed in Section D, other methods of lime addition are being investigated.

As already noted, the addition of lime at the head of the clearwell creates pH conditions that are less than optimum for disinfection.

vii) Summmary

Overall removal of particulate contaminants at Lemieux Island Water Treatment Plant is excellent due to the reliable performance of the rapid sand filters under a wide range of water temperatures, water quality, and flowrates. The post-filter turbidity is generally less than 0.2 NTU.

However, examination of the particulate removal processes individually suggest that improvements can be made, particularly in the cold water months. The flocculator design parameters, G and Gt, are low except at peak summer flowrates. Since detention times are well within MOE Guideline values, means of increasing the G values should be considered. The only practical means of changing the velocity heads at the inlets to each flocculation stage is through reduction in cross-sectional area or increased flowrate. Therefore, the addition of hydraulic control devices to the flocculators to achieve these ends may help improve flocculator performance.

A second area of concern is in the settling basin where three conditions may exist which adversely affect settling basin performance:

- o hydraulic short-circuiting
- o high overflow rates
- o high weir loading rates

In situations where overflow rates are constrained by the physical structure, retrofitting using elements such as tubes or plates can improve settling basin performance. Also, short-circuiting can be greatly reduced by the use of

these devices. Through RMOC studies, plate settlers have already been identified as being capable of enhancing settling basin performance.

The settling basins in the Britannia expansion will be provided with plate settlers and their performance may indicate the possiblity of having the existing Lemieux settling basins fitted with plate settlers.

In conclusion, there is some concern with respect to the performance of the coagulation, flocculation, and sedimentation processes during the cold water months. Mitigative measures including hydraulic control devices in the flocculators and installation of tube or plate settlers in the rectangular sedimentation basins would help improve cold water performance and strengthen an important element of the multiple-barrier concept.

E.2 References

E.1 World Health Organization. Guidelines for Drinking Water Quality, Volume 2. Geneva, Switzerland, 1984.

E.2 Finch, G.R., P.W. Given, and D.W. Smith. A Technology Review of Particle Removal by Water Filtration. Edmonton, Alberta: Alberta Environment, Environmental Protection Services, Standards and Approvals Division, Municipal Engineering Branch. August 1985.

E.3 James M. Montgomery, Consulting Engineers, Inc. Water Treatment Principles and Design. New York, New York: John Wiley & Sons. 1985.

E.4 Hudson, H.E. and E.G. Wagner. Conduct and Use of Jar Tests. Journal of the American Water Works Association. 73(1981):218-223.

E.5 Gore and Storrie Limited. Water Purification Plants Master Plan. Ottawa, Ontario: Regional Municipality of Ottawa-Carleton, 1985.

F. PLANT PERFORMANCE (DISINFECTION)

F.1 Disinfection Practices

Chemical disinfection of Lemieux Island Water Treatment Plant consists of chlorination at two locations:

- prior to the low-lift pumps
- after the clearwell, prior to the high lift pumps

(a) Pre-chlorination

Pre-chlorination has been used for a number of reasons (Ref. F-1):

- control of undesirable microorganisms in the treatment works
- oxidation of soluble iron and manganese species
- improved coagulation
- reduction of colour
- reduction of taste and odour
- removal of some pathogenic bacteria
- oxidation of organic compounds

However, recent concerns regarding the formation of trihalomethanes (THMs) when chlorine reacts with natural humic substances in water has led to the re-evaluation of pre-chlorination practice (Ref. F-2).

In the period 1984 to 1986 pre-chlorination residuals from filters typically ranged between 0.06 to 0.36 mg/L total residual chlorine (TRC). Dosages necessary to achieve the above residuals were typically 1.0 mg/L in the months January to April increasing to between 2.0 to 3.0 mg/L in the warm weather months. The warm weather dosage requirements reflect the increased warm weather chlorine demand of the raw water. Raw water pH was typically 7.1.

As previously noted, pre-chlorination dosage requirements were determined by Quality Control staff utilizing a daily grab sample of filter influent. Residual chlorine measurements are also made at the head of the flocculators and recorded in the operating log.

(b) Post-chlorination

Post-chlorination is provided as the final barrier to the transmission of disease-causing organisms through the plant and to provide a residual in the distribution system. At Lemieux pH is adjusted to approximately 8.7 using slaked lime prior to entering the clearwell. Chlorine is added after the clearwell, before the high-lift pumps, to provide a total chlorine residual. The efficiency of chlorine is greatly reduced at the elevated pH and much longer (8-10 times) contact times are required than at pH 7 (Ref. F-1). Over the three year review period, chlorine doses ranged from 0.73 mg/L in February 1984 to 1.47 mg/L in August 1986.

Total chlorine residual in the finished water ranged from 0.90 to 1.40 mg/L. The proportion of this total chlorine which is free chlorine ranges from 44 to 98%. At the higher chlorine residuals maintained in the summer of 1986, most of the chlorine was free chlorine.

Throughout the study, monthly chlorine tests showed positive results for total chlorine residual throughout the distribution system. However, during the summer months and at the extremities of the distribution system, free chlorine levels were reduced to minimum detectable limits.

F.2 Disinfection Efficiency

Reviewing the disinfection data tabulated in Table 6 (Appendix A) reveals no apparent problems with disinfection at the Lemieux Island Water Treatment Plant. No fecal coliforms have been detected in treated water over the period 1983-1986. The bacteriological problem in the summer of 1986 consisted of 3 total coliforms detected in a treated water sample. This resulted in the decision to increase the post-chlorination doses and increase the residual in the distribution system.

The World Health Organization (Ref. F-4) recommended 0.2 to 0.5 mg/L of free chlorine residual, maintained for 30 min at a pH of less than 8 as the minimum for ensuring good disinfection.

The Lemieux Island plant is usually successful in obtaining a free chlorine residual of greater than 0.5 mg/L prior to the high-lift pumps. However, there are two concerns with the post-chlorination system:

1. there is no controlled contact time for the chlorinated water before it enters the distribution system

2. the pH of the finished water is not optimum for efficient chlorine disinfection

As noted above, free chlorine at a pH of 8.7 takes 8 to 10 times longer to achieve the same degree of disinfection, at the same dose, at pH 7. Coliform indicator bacteria are readily inactivated using chlorine. However, certain bacteria, viruses, and protozoa require higher dose and/or longer contact times for adequate disinfection.

Consideration should be given to moving the chlorine addition point to before the clearwell and to change the pH adjustment point to after the clearwell. This move will provide two benefits:

- free chlorine at pH 6 (filtrate pH) is a very effective disinfectant

- the clearwell will provide 134 min of controlled contact time at 290 ML/d.

The clearwell may require minor modifications to minimize short-circuiting. However, these changes should result in an improved disinfection process.

As well, lime would require degritting to preclude lime deposition in the distribution system. A separate degritter would not be necessary if a lime saturator were employed.

F.3 Chlorinated By-products Formation

Examination of Table 4 (Appendix A) for THM compounds revealed that only chloroform was detected in significant quantities during the first half of 1987 and the last half of 1986. Total THMs were greater than 100 µg/L throughout the last half of 1986 and during May and June of 1987. However, total THMs never exceeded the Ontario Drinking Water Objective of 350 µg/L. If the need to reduce THMs occurs in Ontario, the Lemieux Island Water Treatment Plant may need to take action.

The formation of chloroform is most probably the result of pre-chlorination of Ottawa River water. The most efficient method of reducing THM formation is through removal of the organic precursors prior to adding chlorine (Ref. F-2). The

coagulation/flocculation process has great potential for precursor removal suggesting that the point of chlorine addition should be moved to after the settling basins.

Organic removal would then occur during flocculation/sedimentation. Powdered activated carbon applied in the flocculation/sedimentation stage could also assist in achieving the required organic removal prior to chlorination. Alternatively a non offensive type of pre-disinfectant such as chloranimes or chlorine dioxide can be used. Neither of these are particularly attractive as chloramines are slow to react and chlorine dioxide has the potential for causing taste and odour problems. Another alternative is the use of ozone as a pre-oxidant. Ozone treatment has the potential to deal with the THM problem and also bring about significant reduction in colour, TOC, and hazardous organic chemicals. In 1973-74, the Regional Municipality of Ottawa-Carleton conducted pilot testing with ozone for colour removal.

To reduce the amount of THM formation in the distribution system chloramination could be utilized as a post-disinfectant. It offers the advantages of zero THM formation and greater persistancy as a disinfectant. The decision to use combined chlorine should be considered cautiously given that as a disinfectant its reaction rate is very slow and may not offer adequate protection against accidential contamination from cross-connections or main breaks.

F.4 References

F-1 Fair, G.M., J.C. Geyer, and D.A. Okun. Water and Wastewater Engineering, Volume 2. New York, New York: John Wiley & Sons, 1968.

F-2 American Water Works Association. Treatment Techniques for Controlling Trihalomethanes in Drinking Water. Denver, Colorado, 1982.

F-3 United States National Research Council. Drinking Water and Health. Volume 2. Washington, DC: National Academy Press, 1980.

F-4 World Health Organization. Guidelines for Drinking-Water Quality. Volume 1 and 2, Geneva, Switzerland, 1984.

RECOMMENDATIONS

Flow Measurement

The installation of the treated and filtered water venturis deviate somewhat from ideal practice. However, flow errors resulting from this deviation are considered to be minimal.

Rapid Mix

At present the low lift pump impellers are used for rapid mixing. The effectiveness of this practice has been questioned. It should be noted that the Britannia WTP expansion will incorporate a rapid mix stage. A significant improvement in settled water quality may warrant a similar retrofit of rapid mixing at Lemieux Island.

Flocculators

It has been noted that G values in the winter are lower than those prescribed for flocculation basins. Although retention times appear adequate this does indicate a lack of flexibility for varying plant flows. Nonetheless, the flocculator performance is good. It is recommended that during periods of low flow during the winter months, an evaluation of the removal from service of one set of flocculators be undertaken. This will effectively increase the flow to the remaining flocculators and may result in improved flocculator performance. Alternatively, the installation of hydraulic control devices may provide a more controlled method for increasing G and Gt values.

Settling

It was found that surface and weir loading rates were high, nonetheless, settled water turbidities are generally good. The worst case is in winter flow conditions where turbidities reach 1-2 FTU. The settling basins in the Britannia plant expansion will contain plate settlers. Since there is some indication of short circuiting it is recommended that a single basin in the existing plant be isolated and fitted with plate settlers for trial purposes.

Filters

Filter operation is excellent in providing filtered water turbidities generally less than 0.2 FTU for a variety of settled water qualities.

Disinfection

It was found that pre-chlorination dosages and detention times have provided adequate pre-disinfection. Settled water has consistently shown positive free chlorine residuals. Generally, THM levels in treated water were less than 350 µg/L. In order to minimize THM formation it is recommended that alternatives be investigated such as the use of alternative oxidants (eg. ozone), activated carbon or the movement of chlorine addition to the beginning of the settling basins be investigated.

Two concerns with post-disinfection are the limited contact time and the high pH of the water at the point of chlorine addition.

Fluoride

It was found that the HFS storage area contained no flood wall.

It is recommended that a flood wall be installed to prevent the escape of HFS should a tank leak occur.

pH Control

The existing pH control system produces lime fines. This has been partially controlled by movement of the lime addition point to the head of the clearwell thereby allowing the fines to settle out in the clearwell as opposed to the distribution system. However, this does not allow for an optimum disinfection environment due to the high pH in the clearwell. The use of a degritter or lime water generator will allow moving the lime addition point back to the clearwell discharge. Alternatively, NaOH addition does not have the problems of grit associated with lime.

It should also be noted that although the finished water pH is high it is still mildly aggressive.

Therefore it is recommended that the point of lime addition be moved to the clearwell exit (see lime recommendation) and that the clearwell be baffled to minimize short circuiting. It is also recommended that chloramination be evaluated as an alternative post-disinfectant.

Coagulant

Based on jar tests it is recommended that alum continue to be used as a coagulant. Optimization of alum dosing may be required to lower residual aluminum levels in the treated water which has occasionally been higher than 0.1 mg/L. It is understood that the use of a streaming current type monitor for dosage control has been tested at bench scale. However, since alum dosage is based on pH reduction requirements, streaming current was not considered useful.

Coagulant Aid

The point of addition of the coagulant aid may not be optimum for coagulation/flocculation. It is noted that the expansion does address this problem by allowing flexibility in the selection of the addition point relative to alum addition.

COST IMPLICATION OF RECOMMENDATIONS

New Capital	Studies	Operational Changes
Flocculator Hydraulic Controls - slide gate (manual) $5000 installed each	- series out of service (internal)	
Settling	- one tank plate settlers (internal)	
Pre-Chlorination	- study alternates - oxidants - activated carbon - move pre-disinfection Bench and pilot scale cost - $250-350k	
Coagulant Aid	- identify optimum point of addition (internal)	
Flouride - floodwall (concrete including lining) $5000		
pH Control	- study most effective method of grit removal - degritter - sodium hydroxide (NaOH) addition - clearwell lime generator	

APPENDIX A
TABLES

LIST OF TABLES FOR APPENDIX A

TABLE 1.0: FLOWS (ML/d) FOR LEMIEUX ISLAND

Month	R/T	1986			1985			1984			1983		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Jan	R	238.930	167.890	197.800	246.640	172.800	220.259	267.340	158.590	240.552	244.666	182.389	216.137
	T	233.620	164.890	194.150	238.630	169.150	215.428	247.460	147.920	229.421	229.336	174.870	210.231
Feb	R	252.150	175.540	208.353	246.550	171.050	220.495	267.800	215.960	232.689	248.257	221.436	231.580
	T	246.800	171.750	204.296	241.960	174.940	215.949	245.440	199.720	223.408	241.256	208.752	222.672
Mar	R	248.550	159.460	194.219	202.490	144.930	169.998	220.870	181.120	213.807	246.666	115.287	200.269
	T	243.820	156.880	190.791	199.380	140.570	165.940	211.140	169.430	206.198	241.893	94.114	187.775
Apr	R	229.460	173.250	192.496	212.790	154.580	172.097	232.880	159.420	198.689	234.755	136.289	193.425
	T	225.380	170.040	188.534	207.960	150.920	168.673	244.290	152.850	194.425	221.469	113.986	185.384
May	R	248.200	146.980	186.042	262.680	148.090	199.519	205.290	156.210	175.265	219.790	152.360	188.519
	T	229.780	144.820	183.077	259.800	145.470	196.250	202.910	142.031	171.090	222.356	144.938	181.054
Jun	R	244.200	158.840	196.170	233.880	165.430	202.967	291.500	157.290	225.310	301.190	155.380	229.600
	T	241.930	156.820	193.095	229.780	161.610	199.641	287.340	153.940	222.290	301.695	149.518	224.844
Jul	R	287.400	154.410	212.452	297.850	188.690	236.163	283.130	184.810	227.850	314.780	167.370	246.641
	T	284.120	152.500	210.186	294.520	185.710	232.699	279.730	183.630	225.060	300.900	163.080	241.992
Aug	R	232.800	159.410	190.012	316.320	153.020	224.987	298.410	166.590	215.575	293.160	190.230	241.531
	T	230.540	157.630	187.619	310.840	149.890	221.490	295.600	161.840	211.027	281.980	184.880	234.184
Sep	R	264.040	145.370	182.611	243.540	152.830	194.996	232.350	138.190	179.994	272.280	157.950	225.137
	T	262.270	142.660	180.528	241.990	149.960	192.029	228.410	134.240	176.451.	259.540	149.860	215.821
Oct	R	207.280	145.690	180.501	191.850	139.270	163.307	192.810	140.300	167.375	210.710	158.030	183.376
	T	204.290	143.020	178.256	188.320	137.240	160.941	190.530	137.660	164.132	197.250	153.160	173.914
Nov	R	223.660	125.530	198.570	236.130	151.070	176.751	183.370	118.710	153.250	231.520	135.640	170.423
	T	220.750	123.970	195.122	231.950	148.580	173.566	179.290	115.880	149.984	248.950	127.190	162.100
Dec	R	253.190	178.630	216.609	253.650	158.610	184.341	295.000	157.520	200.054	268.820	163.910	225.809
	T	246.780	175.280	211.461	248.270	156.700	180.860	286.980	152.370	194.672	257.920	155.620	215.873

R = Raw; T = Treated

TABLE 1.1: PER CAPITA CONSUMPTION FOR REGION OF OTTAWA/CARLETON (L/D/CAPITA)

Consumption	1986	1985	1984	1983
Population (1)	540,000	529,000	515,000	508,200
Maximum Day L/D/Cap.	858	948	860	917
Minimum Day L/D/Cap.	365	386	361	372
Average Day L/D/Cap.	598	592	595	596
Ratio MD/AD	1.43	1.60	1.44	1.54

(1) Central Supply System - Operating Statistics 1983-1986

TABLE 2.0: PARTICULATE REMOVAL SUMMARY FOR LEMIEUX ISLAND

Month	Parameter		1986			1985			1984			1983		
			Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Jan	Turbidity (FTU)	R	1.8	1.2	1.4	2.4	1.8	2.2	1.5	1.1	1.2	3.4	1.6	2.1
		T	0.48	0.30	0.40	0.56	0.25	0.44	0.54	0.38	0.43	0.55	0.32	0.41
	Colour (TCU)	R	49	37	41	48	39	44	50	42	46	49	41	45
		T	4	3	4	4	4	4	5	4	4	4	4	4
	Alum (mg/L)		33	29	31	34	28	31	34	29	33	36	32	35
	Sodium Silicate (mg/L)		2.36	1.00	1.65	1.42	0.94	1.30	1.31	0.62	1.11	1.60	0.88	1.22
	Lime (mg/L)		14	14	14	12	12	12	17	13	15	16	10	14
	pH	R	7.2	6.9	7.0	7.3	7.0	7.1	7.3	7.0	7.1	7.2	7.0	7.1
		T	9.0	8.6	8.8	8.9	8.5	8.7	9.0	8.5	8.8	8.9	8.5	8.7
	Temperature (°C)		1.0	0.5	0.7	1.0	0.2	0.5	1.0	0.2	0.4	0.2	0.0	0.1
Feb	Turbidity (FTU)	R	2.8	1.8	2.4	3.2	2.1	2.6	3.2	1.4	2.0	2.0	1.7	1.9
		T	0.71	0.32	0.46	0.52	0.35	0.44	0.89	0.37	0.52	0.54	0.36	0.43
	Colour (TCU)	R	50	32	42	47	40	43	43	36	40	49	41	44
		T	5	4	4	4	4	4	4	4	4	4	4	4
	Alum (mg/L)		32	28	30	30	28	29	37	30	34	34	29	31
	Sodium Silicate (mg/L)		2.35	1.02	1.86	1.72	1.27	1.39	1.58	0.95	1.30	1.59	1.09	1.35
	Lime (mg/L)		14	14	14	12	12	12	18	12	14	16	9	13
	pH	R	7.1	6.9	7.0	7.1	6.8	7.0	7.1	6.9	7.0	7.2	6.9	7.0
		T	8.9	8.6	8.7	8.9	8.6	8.7	9.0	8.3	8.8	9.1	8.5	8.8
	Temperature (°C)		0.9	0.5	0.8	1.1	0.2	0.6	1.1	0.2	0.6	0.5	0.0	0.1
Mar	Turbidity (FTU)	R	6.8	2.4	3.2	7.4	3.0	4.3	2.7	2.0	2.3	11.0	1.8	4.2
		T	0.75	0.35	0.51	0.87	0.28	0.49	1.0	0.36	0.64	0.53	0.32	0.43
	Colour (TCU)	R	47	36	40	46	33	41	46	38	42	50	38	44
		T	5	4	4	5	4	4	5	4	4	4	4	4
	Alum (mg/L)		36	28	31	40	28	34	43	38	40	39	29	32
	Sodium Silicate (mg/L)		2.06	0.39	1.33	2.92	0.66	1.58	1.80	1.18	1.50	2.35	1.11	1.40
	Lime (mg/L)		14	14	14	15	11	13	19	13	16	17	9	14
	pH	R	7.2	6.9	7.0	7.2	6.9	7.0	7.2	7.0	7.1	7.3	6.9	7.1
		T	8.9	8.6	8.8	8.9	8.7	8.8	9.0	8.5	8.8	9.1	8.6	8.8
	Temperature (°C)		1.3	0.4	0.8	1.4	0.5	1.0	1.5	0.3	0.8	0.5	0.0	0.1

R = Raw; T= Treated

TABLE 2.0 (cont'd): PARTICULATE REMOVAL SUMMARY FOR LEMIEUX ISLAND

Month	Parameter		1986			1985			1984			1983		
			Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Apr	Turbidity (FTU)	R	8.4	2.0	3.9	19.0	4.0	9.8	20.0	2.3	6.7	7.4	2.7	4.2
		T	0.74	0.25	0.43	0.78	0.32	0.43	1.4	0.42	0.69	0.73	0.31	0.43
	Colour (TCU)	R	45	33	39	50	35	45	75	37	50	48	39	42
		T	5	3	4	4	3	4	4	3	4	4	4	4
	Alum (mg/L)		43	29	35	43	37	40	42	37	39	42	34	39
	Sodium Silicate (mg/L)		1.51	0.70	1.09	2.11	1.09	1.60	1.65	0.07	1.21	2.13	1.04	1.38
	Lime (mg/L)		14	14	14	17	13	14	20	14	16	19	14	15
	pH	R	7.3	7.0	7.1	7.5	7.0	7.2	7.4	7.1	7.3	7.4	6.9	7.1
		T	8.7	8.6	8.7	8.8	8.6	8.7	9.0	8.6	8.8	9.1	8.5	8.8
	Temperature(°C)		10.8	1.6	5.4	6.8	0.9	3.4	9.2	1.5	4.6	6.0	0.0	2.4
May	Turbidity (FTU)	R	5.2	1.4	2.5	4.4	1.7	2.4	3.2	1.5	2.2	9.0	2.5	3.9
		T	1.5	0.22	0.47	0.47	0.20	0.27	1.8	0.42	0.70	0.85	0.26	0.39
	Colour (TCU)	R	42	34	38	50	37	42	52	32	39	60	39	44
		T	5	4	4	5	3	4	5	3	4	4	4	4
	Alum (mg/L)		35	24	28	36	25	27	41	35	38	41	30	38
	Sodium Silicate (mg/L)		1.04	0.23	0.59	1.72	0.24	1.13	0.58	0.12	0.31	1.72	0.51	1.19
	Lime (mg/L)		14	14	14	13	9	11	20	12	15	15	11	15
	pH	R	7.5	7.1	7.2	7.3	6.8	7.0	7.5	7.0	7.3	7.5	7.1	7.3
		T	8.9	8.6	8.7	8.9	8.6	8.7	9.1	8.6	8.8	9.1	8.6	8.8
	Temperature(°C)		17.5	9.5	13.1	15.1	7.2	11.2	14.4	9.2	11.6	12.8	7.0	9.7
Jun	Turbidity (FTU)	R	3.0	1.4	1.9	2.4	1.8	2.0	3.2	1.8	2.4	3.3	1.8	2.3
		T	1.10	0.36	0.63	0.32	0.18	0.23	0.45	0.28	0.31	0.37	0.20	0.29
	Colour (TCU)	R	39	31	36	49	35	41	47	36	41	49	37	43
		T	5	4	4	4	3	3	5	4	4	4	4	4
	Alum (mg/L)		35	30	32	27	25	25	34	23	26	30	24	26
	Sodium Silicate (mg/L)		0.81	0.34	0.54	1.35	0.13	0.66	0.67	0.17	0.52	0.97	0.46	0.57
	Lime (mg/L)		14	14	14	12	12	12	14	10	12	16	12	14
	pH	R	7.5	7.2	7.4	7.4	7.0	7.3	7.3	7.1	7.2	7.3	7.0	7.1
		T	9.0	8.5	8.7	8.9	8.6	8.7	8.9	8.5	8.7	9.4	8.6	8.9
	Temperature(°C)		20.2	16.5	18.3	19.5	14.9	17.4	20.5	13.4	18.3	20.5	12.2	16.5

R = Raw; T= Treated

TABLE 2.0 (cont'd): PARTICULATE REMOVAL SUMMARY FOR LEMIEUX ISLAND

Month	Parameter		1986			1985			1984			1983		
			Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Jul	Turbidity (FTU)	R	1.5	0.8	1.2	2.2	1.1	1.3	3.4	1.8	2.5	2.4	1.1	1.9
		T	2.50	0.37	1.18	0.42	0.18	0.26	0.48	0.24	0.32	0.40	0.16	0.27
	Colour (TCU)	R	39	30	32	39	30	33	44	36	39	46	25	37
		T	5	4	5	4	3	3	5	4	4	5	4	4
	Alum (mg/L)		35	28	32	28	25	27	29	21	25	28	24	27
	Sodium Silicate (mg/L)		1.32	0.40	0.85	1.16	0.21	0.56	0.98	0.26	0.55	0.50	0.20	0.40
	Lime (mg/L)		17	12	14	14	10	14	13	11	13	14	14	14
	pH	R	7.6	7.4	7.5	7.5	7.3	7.4	7.4	7.0	7.2	7.4	7.1	7.3
		T	8.9	8.5	8.7	9.1	8.6	8.8	9.4	8.6	8.8	9.2	8.6	8.9
	Temperature (°C)		24.8	20.0	21.6	24.5	19.7	22.5	23.0	20.3	21.6	24.5	20.5	22.6
Aug	Turbidity (FTU)	R	2.5	0.8	1.1	1.4	0.8	1.1	3.2	1.5	1.8	1.8	1.0	1.3
		T	3.5	1.1	2.1	0.32	0.18	0.23	0.42	0.20	0.28	0.38	0.16	0.26
	Colour (TCU)	R	37	28	32	42	30	38	41	32	38	34	27	31
		T	5	2	4	4	3	3	5	4	4	5	3	4
	Alum (mg/L)		36	32	33	26	23	24	30	24	27	30	26	27
	Sodium Silicate (mg/L)		1.22	0.60	0.93	0.65	0.26	0.46	0.88	0.18	0.58	0.77	0.14	0.42
	Lime (mg/L)		18	14	14	14	11	14	16	10	13	15	13	14
	pH	R	7.6	7.2	7.4	7.5	7.2	7.3	7.4	7.1	7.3	7.5	7.2	7.4
		T	9.0	8.4	8.7	9.0	8.6	8.8	8.9	8.5	8.7	9.2	8.6	8.8
	Temperature (°C)		23.5	19.0	22.3	23.5	20.2	22.1	24.3	20.0	22.7	24.1	21.9	23.0
Sep	Turbidity (FTU)	R	4.2	0.8	1.6	1.0	0.8	0.9	3.7	1.5	1.9	2.3	1.1	1.6
		T	5.3	1.2	2.8	0.27	0.16	0.21	0.38	0.22	0.30	0.34	0.18	0.25
	Colour (TCU)	R	82	28	31	45	33	37	42	38	40	37	29	32
		T	5	4	4	3	3	3	4	4	4	4	3	4
	Alum (mg/L)		42	31	36	30	25	27	32	29	30	33	29	30
	Sodium Silicate (mg/L)		1.28	0.47	1.05	0.62	0.04	0.33	0.61	0.04	0.31	1.06	0.26	0.49
	Lime (mg/L)		14	12	14	14	14	14	12	11	12	15	10	13
	pH	R	7.6	7.2	7.4	7.5	7.3	7.4	7.4	7.2	7.3	7.5	7.3	7.4
		T	8.7	8.4	8.5	8.9	8.6	8.7	8.9	8.4	8.7	9.2	8.2	8.8
	Temperature (°C)		19.8	15.1	17.2	20.4	17.5	19.1	21.1	15.0	18.3	24.2	17.2	20.7

R = Raw; T= Treated

TABLE 2.0 (cont'd): PARTICULATE REMOVAL SUMMARY FOR LEMIEUX ISLAND

Month	Parameter		1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.	1984 Max.	1984 Min.	1984 Avg.	1983 Max.	1983 Min.	1983 Avg.
Oct	Turbidity (FTU)	R	3.7	1.4	1.8	2.7	1.0	1.3	2.5	1.5	1.9	5.3	1.4	2.7
		T	9.5	0.55	3.4	0.26	0.18	0.22	0.38	0.21	0.30	0.41	0.19	0.31
	Colour (TCU)	R	42	30	36	43	31	36	45	39	42	43	30	35
		T	6	3	5	4	3	3	4	4	4	4	3	4
	Alum (mg/L)		46	40	43	31	27	28	31	29	30	34	30	32
	Sodium Silicate (mg/L)		1.48	0.42	0.78	0.79	0.08	0.30	0.73	0.10	0.43	1.00	0.19	0.43
	Lime (mg/L)		15	12	14	14	14	14	13	10	11	14	11	14
	pH	R	7.6	7.2	7.5	7.5	7.3	7.4	7.4	7.0	7.2	7.5	7.2	7.4
		T	8.7	8.0	8.3	8.9	8.6	8.8	9.0	8.5	8.8	9.0	8.6	8.8
	Temperature (°C)		15.9	10.1	13.0	17.5	9.7	13.5	15.8	11.5	12.3	18.2	8.5	13.2
Nov	Turbidity (FTU)	R	2.1	1.6	1.9	1.8	1.3	1.5	4.8	1.8	2.5	5.3	1.6	2.0
		T	0.84	0.36	0.48	0.45	0.18	0.30	0.55	0.25	0.37	0.50	0.27	0.38
	Colour (TCU)	R	45	30	40	43	31	38	47	40	43	43	35	38
		T	4	3	4	4	3	3	4	4	4	5	4	4
	Alum (mg/L)		45	32	38	32	29	31	31	29	29	40	30	35
	Sodium Silicate (mg/L)		1.29	0.59	0.92	1.06	0.19	0.65	1.00	0.22	0.57	1.30	0.31	0.92
	Lime (mg/L)		19	12	14	14	14	14	12	10	12	14	12	14
	pH	R	7.5	7.0	7.3	7.5	7.0	7.3	7.4	7.1	7.3	7.5	7.2	7.3
		T	8.8	8.2	8.4	9.0	8.6	8.8	9.2	8.6	8.9	8.9	8.6	8.8
	Temperature (°C)		9.3	2.2	5.5	9.6	2.2	6.1	11.9	3.0	6.5	9.0	3.0	5.5
Dec	Turbidity (FTU)	R	2.1	1.8	1.9	7.6	1.2	1.9	2.4	1.5	1.9	6.4	1.2	1.9
		T	1.20	0.36	0.59	0.48	0.27	0.34	0.78	0.32	0.44	0.55	0.32	0.42
	Colour (TCU)	R	45	39	42	42	34	37	49	43	46	48	37	42
		T	5	3	4	4	3	3	6	4	4	4	4	4
	Alum (mg/L)		41	31	36	35	31	32	34	28	31	40	29	35
	Sodium Silicate (mg/L)		1.62	0.71	1.25	2.11	0.67	1.22	2.73	0.08	1.10	2.05	0.69	1.12
	Lime (mg/L)		18	14	14	14	14	14	12	12	12	17	11	14
	pH	R	7.3	7.0	7.2	7.3	7.0	7.1	7.3	7.0	7.1	7.4	7.1	7.3
		T	8.9	8.6	8.7	8.9	8.6	8.8	8.9	8.6	8.8	8.9	8.3	8.8
	Temperature (°C)		2.0	0.6	1.0	2.5	0.4	0.9	3.0	0.0	1.4	2.5	0.2	0.7

R = Raw; T= Treated

TABLE 2.1: PARTICULATE REMOVAL PROFILE (1986) JANUARY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.3	2.2	0.12	0.42	44	3	33	1.11	14	7.2	8.6	0.7
2	1.2	1.7	0.22	0.45	46	4	32	1.06	14	7.2	8.6	0.6
3	1.2	2.0	0.31	0.42	42	4	32	1.21	14	7.2	8.8	1.0
4	1.3	1.9	0.17	0.36	41	3	32	1.68	14	7.1	8.8	0.6
5	1.3	1.6	0.20	0.38	41	3	32	1.52	14	7.1	818	0.6
6	1.2	2.0	0.12	0.40	48	4	32	1.96	14	7.2	8.9	0.5
7	1.2	1.8	0.28	0.40	49	4	32	1.96	14	7.2	8.6	0.5
8	1.3	1.6	0.12	0.44	49	4	31	1.81	14	7.1	8.8	0.5
9	1.2	1.9	0.16	0.48	39	4	31	1.57	14	7.0	8.9	0.6
10	1.3	1.7	0.16	0.32	44	3	30	1.00	14	7.0	8.7	0.9
11	1.3	2.2	0.16	0.46	46	4	31	1.41	14	7.1	8.6	0.8
12	1.3	2.2	0.19	0.42	49	4	30	1.05	14	7.0	8.7	0.8
13	1.2	2.0	0.26	0.49	43	4	30	1.64	14	6.9	8.8	0.8
14	1.2	2.0	0.22	0.48	42	4	30	1.90	14	7.0	8.8	0.6
15	1.4	2.7	0.15	0.35	37	4	30	1.98	14	6.9	9.0	0.5
16	1.4	2.0	0.18	0.38	40	4	30	1.88	14	7.0	8.8	0.5
17	1.4	2.0	0.15	0.40	37	4	31	1.48	14	7.0	8.7	0.7
18	1.4	1.7	0.14	0.34	37	4	30	1.42	14	7.0	8.9	1.0
19	1.4	2.0	0.14	0.36	37	4	30	1.73	14	6.9	8.8	1.0
20	1.5	1.8	0.26	0.37	37	4	31	1.29	14	7.0	8.8	0.8
21	1.5	1.9	0.22	0.42	37	4	31	1.78	14	7.0	8.7	0.8
22	1.5	1.5	0.20	0.32	37	4	30	1.47	±4	7.0	8.7	0.8
23	1.5	2.0	0.12	0.30	37	4	30	1.08	14	7.0	8.7	0.8
24	1.5	1.8	0.18	0.42	37	4	29	2.27	14	7.1	8.8	0.6
25	1.7	1.8	0.37	0.38	37	4	29	2.35	14	7.1	8.8	0.6
26	1.8	2.0	0.28	0.35	37	4	30	1.89	14	7.0	8.8	0.8
27	1.7	1.9	0.20	0.40	37	4	30	1.15	14	7.0	8.7	0.6
28	1.7	1.9	0.22	0.35	44	4	30	1.93	14	7.0	8.8	0.6
29	1.8	2.0	0.22	0.42	40	4	30	1.72	14	7.1	8.8	0.6
30	1.8	2.1	0.26	0.44	40	4	30	2.36	14	7.1	8.9	0.8
31	1.8	1.9	0.20	0.37	46	4	29	1.38	14	7.0	8.7	0.8

NS - No sample

TABLE 2.1 (cont'd): PARTICULATE REMOVAL PROFILE (1986) MAY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	2.0	1.2	0.15	0.28	35	4	28	1.04	14	7.2	8.8	11.2
2	2.5	1.2	0.16	0.26	41	4	28	0.96	14	7.3	8.7	10.5
3	2.5	1.3	0.12	0.24	42	4	25	0.69	14	7.3	8.7	9.6
4	2.9	1.4	0.15	0.27	41	4	28	0.68	14	7.2	8.7	9.5
5	2.2	1.5	0.15	0.35	34	4	28	0.72	14	7.2	8.8	10.0
6	2.2	1.3	0.16	0.35	34	4	28	0.64	14	7.3	8.8	10.0
7	2.1	1.6	0.16	0.32	NS	4	28	0.64	14	7.1	8.7	10.0
8	2.2	1.2	0.10	0.32	34	4	29	0.60	14	7.2	8.6	10.2
9	2.2	1.5	0.18	0.32	34	4	27	0.31	14	7.2	8.7	10.7
10	1.9	1.5	0.14	0.25	36	4	26	0.50	14	7.1	8.7	11.5
11	1.9	1.9	0.13	0.24	36	4	26	0.72	14	7.1	8.7	12.1
12	1.9	1.7	0.14	0.25	39	4	26	0.57	14	7.1	8.8	12.5
13	1.8	1.5	0.18	0.28	39	4	24	0.72	14	7.3	8.8	12.8
14	1.7	1.6	0.14	0.30	39	4	25	0.74	14	7.1	8.7	12.3
15	1.6	1.6	0.22	0.29	36	4	24	0.60	14	7.2	8.7	13.6
16	1.6	1.4	0.27	0.32	36	4	24	0.64	14	7.2	8.7	13.3
17	1.4	1.3	0.18	0.32	36	4	24	0.43	14	7.2	8.7	13.5
18	1.4	1.5	0.20	0.25	36	4	24	0.46	14	7.2	8.9	14.3
19	1.5	1.4	0.15	0.22	36	4	24	0.43	14	7.2	8.8	14.0
20	1.6	1.2	0.13	0.28	36	5	24	0.23	14	7.2	8.8	14.0
21	1.8	1.8	0.20	0.32	36	4	24	0.40	14	7.2	8.7	13.8
22	1.6	1.8	0.15	0.30	36	4	24	0.64	14	7.2	8.7	14.0
23	5.2	1.8	0.25	0.32	42	4	25	0.38	14	7.1	8.7	13.9
24	7.1	1.7	0.35	0.26	42	4	29	0.34	14	7.2	8.9	13.9
25	4.0	1.7	0.12	0.40	42	4	31	0.52	14	7.1	8.7	14.5
26	4.2	2.0	0.22	0.66	42	5	32	0.61	14	7.3	8.7	15.2
27	4.0	1.1	0.12	1.50	43	5	34	0.72	14	7.4	8.8	15.8
28	3.4	1.3	0.12	1.20	38	5	35	0.54	14	7.5	8.8	16.7
29	2.6	1.2	0.14	1.10	38	5	35	0.75	14	7.5	8.6	17.4
30	2.2	1.2	0.18	1.20	38	5	34	0.67	14	7.5	8.7	17.5
31	2.0	1.0	0.16	1.60	36	5	35	0.43	14	7.4	8.8	17.0

NS - No sample

TABLE 2.1 (cont'd): PARTICULATE REMOVAL PROFILE (1986) JULY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.5	0.9	0.08	0.37	32	4	31	0.51	12	7.4	8.7	20.0
2	1.4	1.1	0.12	0.56	35	4	31	0.47	12	7.4	8.7	20.3
3	1.4	1.0	0.15	0.40	35	4	32	0.58	14	7.5	8.5	20.2
4	1.4	0.9	0.12	0.63	35	4	31	0.40	14	7.5	8.8	20.4
5	1.5	1.2	0.12	0.48	39	4	30	0.51	14	7.3	8.7	20.5
6	1.2	1.2	0.10	0.76	33	5	30	0.57	14	7.4	8.6	20.7
7	1.4	1.0	0.10	0.90	33	5	28	0.58	14	7.4	8.8	21.0
8	1.3	1.2	0.10	0.74	32	5	30	0.68	14	7.5	8.6	22.1
9	1.2	1.0	0.12	1.40	34	5	32	0.90	13	7.5	8.7	22.4
10	1.3	0.8	0.12	0.90	34	5	32	0.98	15	7.5	8.7	21.8
11	1.5	0.8	0.10	1.40	NS	5	32	0.67	14	7.5	8.7	21.4
12	1.5	0.9	0.21	0.82	33	4	32	0.70	14	7.5	8.8	20.7
13	1.5	0.8	0.10	0.85	32	4	33	0.72	14	7.4	8.6	20.5
14	1.3	0.8	0.10	1.40	NS	5	33	1.06	13	7.5	8.7	20.6
15	1.2	1.2	0.10	1.80	30	5	29	0.61	15	7.5	8.9	21.2
16	1.2	1.0	0.10	2.50	32	5	32	0.69	14	7.6	8.8	22.0
17	1.2	1.1	0.12	1.20	34	5	31	0.63	14	7.5	8.7	22.2
18	1.2	1.2	0.14	1.40	30	5	32	1.11	14	7.6	8.5	22.2
19	1.3	1.3	0.56	1.50	33	5	32	1.06	16	7.4	8.5	22.6
20	1.2	1.2	0.14	0.80	32	5	32	1.00	16	7.4	8.7	22.9
21	1.0	0.9	0.17	1.50	31	5	32	0.98	17	7.4	8.6	22.2
22	1.0	1.0	0.10	1.00	32	5	32	1.10	14	7.5	8.6	22.5
23	1.0	0.8	0.24	1.20	32	5	32	1.31	14	7.5	8.7	22.8
24	1.0	1.0	0.08	1.50	30	5	32	1.22	14	7.5	8.7	23.4
25	1.0	1.0	0.14	1.80	30	5	32	1.32	13	7.5	8.8	24.5
26	1.0	0.6	0.10	1.30	30	5	35	0.96	14	7.4	8.8	24.8
27	1.0	0.8	0.15	1.70	30	5	32	0.68	14	7.4	8.7	24.8
28	1.0	0.8	0.10	1.80	NS	5	33	1.00	14	7.5	8.9	24.6
29	0.8	0.8	0.12	1.30	30	5	32	0.81	14	7.4	8.7	24.8
30	1.0	0.7	0.16	1.30	30	5	32	0.72	13	7.3	8.8	24.6
31	1.0	0.6	0.15	1.50	32	5	32	0.70	13	7.4	8.7	24.5

NS - No sample

TABLE 2.1 (cont'd): PARTICULATE REMOVAL PROFILE (1986) OCTOBER/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.4	0.8	0.08	3.0	32	5	41	0.71	12	7.6	8.3	15.5
2	1.4	1.0	0.15	3.7	34	5	43	1.19	12	7.6	8.5	15.2
3	1.5	1.0	0.10	3.2	30	5	42	1.22	14	7.5	8.5	15.0
4	1.7	1.1	0.27	3.0	33	3	42	1.30	12	7.4	8.4	15.9
5	1.4	1.0	0.16	2.2	33	3	41	1.30	13	7.4	8.2	15.4
6	2.0	2.0	0.08	4.2	37	5	42	1.11	14	7.5	8.6	14.8
7	3.4	1.2	0.18	4.0	NS	5	41	1.48	13	7.5	8.4	14.8
8	3.7	1.2	0.23	4.2	36	5	42	0.73	14	7.6	8.6	14.5
9	2.4	1.2	0.14	5.5	34	5	41	0.60	14	7.6	8.6	14.3
10	2.4	1.0	0.10	8.5	34	5	42	0.75	14	7.6	8.5	13.8
11	2.2	1.0	0.10	5.5	32	5	44	0.51	12	7.5	8.7	13.0
12	2.1	1.1	0.18	6.0	40	5	44	0.42	14	7.6	8.6	12.9
13	2.0	1.1	0.10	5.0	42	5	44	0.54	14	7.6	8.6	13.4
14	1.7	1.2	0.12	4.5	42	5	43	0.73	14	7.5	8.4	13.5
15	1.8	1.0	0.18	9.5	NS	6	44	0.62	15	7.6	8.2	13.0
16	1.7	1.2	0.20	5.4	39	5	44	0.72	14	7.6	8.3	12.4
17	1.7	1.1	0.12	2.0	37	5	44	0.65	14	7.5	8.3	12.5
18	1.6	1.1	0.33	3.5	39	5	43	0.64	14	7.4	8.0	11.3
19	1.6	1.2	0.33	3.6	39	5	43	0.63	14	7.2	8.4	11.6
20	1.7	1.1	0.10	2.7	39	5	43	0.67	14	7.6	8.4	12.2
21	1.5	1.0	0.12	2.4	39	5	43	0.72	14	7.6	8.3	12.4
22	1.5	1.0	0.10	1.7	40	5	43	0.78	14	7.6	8.5	12.6
23	1.5	1.5	0.22	2.0	39	5	46	0.70	14	7.5	8.5	13.0
24	1.7	1.0	0.20	2.0	39	5	44	0.67	14	7.5	8.6	12.9
25	1.5	1.3	0.12	1.2	39	5	41	0.66	14	7.4	8,2	11.8
26	1.5	1.2	0.10	2.1	39	5	43	0.63	14	7.4	8.0	11.3
27	1.5	1.0	0.20	1.5	37	4	43	0.62	14	7.4	8.1	11.0
28	1.5	1.1	0.22	0.95	38	4	42	0.75	14	7.4	8.2	11.2
29	1.6	1.0	0.18	0.65	42	4	40	0.69	14	7.3	8.1	11.0
30	1.7	1.5	0.28	0.65	42	4	41	0.63	14	7.3	8.0	10.5
31	1.0	0.6	0.15	1.50	32	5	32	0.70	13	7.4	8.7	24.5

NS- No sample

TABLE 2.2: PARTICULATE REMOVAL PROFILE (1985) JANUARY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.8	1.8	0.15	0.47	45	4	31	0.94	12	7.1	8.8	1.0
2	2.2	2.5	0.28	0.42	45	4	30	1.20	12	7.2	8.7	0.8
3	2.2	2.4	0.31	0.42	46	4	28	1.22	12	7.2	8.7	0.8
4	2.2	2.1	0.15	0.25	48	4	29	1.19	12	7.2	8.0	1.0
5	2.1	2.3	0.22	0.45	45	4	31	1.21	12	7.2	8.6	0.8
6	2.1	2.4	0.24	0.50	43	4	31	1.31	12	7.3	8.8	0.8
7	2.2	2.6	0.12	0.56	45	4	32	1.40	12	7.2	8.9	0.8
8	2.3	2.8	0.12	0.42	48	4	34	1.25	12	7.2	8.7	0.5
9	2.2	2.4	0.25	0.45	46	4	33	1.40	12	7.1	8.7	0.5
10	2.2	2.6	0.22	0.47	45	4	33	1.36	12	7.1	8.8	0.5
11	2.2	2.3	0.12	0.46	45	4	33	1.23	12	7.0	8.7	0.5
12	2.3	2.0	0.15	0.48	42	4	33	1.25	12	7.2	8.7	0.2
13	2.3	3.2	0.20	0.46	41	4	33	1.25	12	7.2	8.5	0.2
14	2.1	3.0	0.12	0.52	42	4	32	1.38	12	7.1	8.7	0.3
15	2.1	2.4	0.12	0.42	48	4	29	1.26	12	7.3	8.6	0.2
16	2.2	2.4	0.14	0.54	43	4	30	1.33	12	7.2	8.8	0.2
17	2.1	2.1	0.11	0.44	42	4	29	1.30	12	7.3	8.7	0.5
18	2.3	2.2	0.16	0.47	44	4	29	1.41	12	7.0	8.7	0.5
19	2.3	1.7	0.15	0.42	42	4	29	1.28	12	7.0	8.8	0.3
20	2.4	2.0	0.12	0.48	42	4	30	1.32	12	7.1	8.7	0.2
21	2.2	2.4	0.20	0.46	42	4	29	1.31	12	7.0	8.7	0.2
22	2.1	2.4	0.18	0.37	46	4	29	1.38	12	7.0	8.6	0.4
23	2.2	2.5	0.15	0.36	45	4	30	1.35	12	7.1	8.7	0.5
24	2.0	2.6	0.16	0.44	42	4	29	1.37	12	7.2	8.9	0.5
25	2.2	2.3	0.15	0.42	42	4	30	1.29	12	7.2	8.8	0.5
26	2.1	1.8	0.15	0.30	45	4	30	1.22	12	7.1	8.7	0.5
27	2.2	1.7	0.20	0.35	45	4	30	1.24	12	7.1	8.5	0.8
28	2.4	2.3	0.24	0.46	45	4	29	1.42	12	7.0	8.8	0.7
29	2.3	2,2	0.14	0.48	39	4	29	1.23	12	7.0	8.8	0.5
30	2.2	2.4	0.22	0.52	42	4	30	1.38	12	7.2	8.7	0.6
31	2.3	2.5	0.18	0.44	NS	4	30	1.28	12	7.1	8.7	0.5

NS - No sample

TABLE 2.2 (cont'd): PARTICULATE REMOVAL PROFILE (1985) MAY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	3.4	1.5	0.18	0.47	49	4	36	1.17	13	6.9	8.8	7.2
2	3.2	1.5	0.16	0.38	48	4	33	1.40	12	6.9	8.7	7.2
3	3.4	2.4	0.26	0.32	46	4	34	1.67	12	6.9	8.7	7.4
4	4.4	2.3	0.29	0.33	46	5	31	1.61	12	6.8	8.7	8.1
5	4.1	2.0	0.23	0.24	46	4	31	1.60	11	6.9	8.6	8.2
6	2.8	1.8	0.18	0.28	48	4	32	1.61	12	6.8	8.7	8.8
7	2.6	1.2	0.16	0.31	50	4	30	1.63	11	7.1	8.8	8.6
8	2.8	1.0	0.15	0.28	39	4	29	1.49	10	6.8	8.8	8.6
9	2.5	1.0	0.14	0.27	39	4	29	1.64	11	6.9	8.7	8.7
10	2.4	0.9	0.16	0.26	41	4	29	1.47	13	7.0	8.8	8.9
11	2.3	0.8	0.21	0.28	37	4	29	1.63	9	7.2	8.8	9.1
12	2.8	1.1	0.25	0.23	38	4	29	1.72	10	7.1	8.7	9.6
13	2.3	1.2	0.22	0.26	38	4	27	1.56	10	7.1	8.7	10.3
14	2.2	1.0	0.15	0.24	38	4	27	1.61	10	7.0	8.7	10.6
15	2.2	1.0	0.18	0.32	39	4	27	1.62	10	7.0	8.7	11.2
16	2.1	1.7	0.18	0.25	44	4	25	1.62	10	7.0	8.8	11.6
17	2.2	1.4	0.16	0.24	42	4	25	1.35	9	1.1	8.7	12.1
18	2.1	1.2	0.14	0.22	39	4	25	0.82	10	7.1	8.8	12.2
19	2.1	1.0	0.15	0.24	39	4	25	0.75	10	7.0	8.8	12.2
20	2.0	1.2	0.16	0.28	43	4	25	0.54	10	7.0	8.8	12.4
21	1.7	1.3	0.15	0.25	43	4	25	0.24	10	7.1	8.7	13.0
22	1.8	1.0	0.14	0.27	41	4	25	0.62	9	7.1	8.7	13.6
23	1.9	1.1	0.17	0.26	41	4	25	1.02	9	7.2	8.6	13.3
24	2.0	1.2	0.18	0.25	39	4	25	1.00	9	7.0	8.8	13.6
25	2.2	0.8	0.15	0.24	44	4	25	0.73	12	7.1	8.7	14.1
26	1.8	1.3	0.18	0.33	41	3	25	0.57	9	7.1	8.7	14.5
27	1.8	1.2	0.16	0.31	42	4	25	0.57	10	7.1	8.7	14.5
28	1.7	1.4	0.18	0.26	41	4	25	0.56	12	7.1	8.8	14.2
29	1.7	1.3	0.11	0.20	38	4	25	0.70	12	7.3	8.9	14.4
30	1.7	1.0	0.16	0.24	39	4	25	0.71	12	7.3	8.8	15.1
31	1.7	1.0	0.12	0.20	-	3	26	0.66	12	7.2	8.7	15.1

NS - No sample

TABLE 2.2 (cont'd): PARTICULATE REMOVAL PROFILE (1985) JULY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.8	1.4	0.14	0.22	38	3	26	1.04	10	7.3	8.7	19.7
2	1.5	1.5	0.15	0.25	38	3	26	0.94	14	7.4	8.7	20.0
3	1.5	1.5	0.12	0.22	35	3	27	0.70	14	7.4	8.6	20.8
4	1.4	1.6	0.10	0.23	32	3	27	0.73	14	7.3	8.7	21.5
5	1.4	1.8	0.15	0.22	36	3	27	0.63	14	7.4	8.8	22.0
6	1.3	0.8	0.14	0.24	32	3	27	0.33	14	7.3	8.7	22.0
7	1.3	1.0	0.21	0.25	36	3	27	0.17	14	7.3	8.8	22.0
8	1.4	1.5	0.14	0.23	36	3	28	0.51	14	7.4	8.6	22.5
9	1.2	1.8	0.18	0.32	35	3	27	1.06	14	7.4	8.8	22.5
10	1.4	1.1	0.20	0.32	38	3	27	0.71	14	7.4	8.8	23.0
11	1.3	1.0	0.24	0.34	39	3	27	0.70	14	7.5	8.8	22.5
12	1.3	1.0	0.12	0.25	31	3	27	1.16	14	7.4	8.8	23.0
13	1.3	0.7	0.08	0.22	32	4	28	1.07	14	7.4	8.7	22.0
14	1.2	0.7	0.13	0.28	32	3	28	0.45	14	7.4	9.1	22.2
15	1.2	0.8	0.12	0.27	32	3	27	0.36	14	7.4	8.8	22.5
16	1.2	0.6	0.11	0.25	32	3	27	0.61	14	7.4	8.8	22.5
17	1.2	1.1	0.16	0.27	30	3	27	0.23	14	7.4	8.9	22.8
18	1.1	1.1	0.10	0.26	31	3	27	0.33	14	7.4	8.8	24.1
19	1.2	0.8	0.10	0.42	30	4	27	0.21	14	7.4	8.8	24.5
20	1.2	0.7	0.12	0.28	30	3	27	0.29	14	7.4	8.7	24.5
21	1.2	1.0	0.15	0.32	30	3	27	0.41	14	7.4	8.7	24.5
22	1.2	0.7	0.15	0.26	30	3	27	0.39	14	7.4	8.7	23.5
23	1.3	0.6	0.10	0.22	30	3	28	0.38	14	7.4	8.6	22.5
24	1.2	1.0	0.12	0.25	30	3	27	0.43	14	7.4	8.6	23.0
25	2.2	1.0	0.10	0.26	35	3	27	0.68	14	7.5	8.9	23.2
26	1.3	1.0	0.12	0.26	33	3	27	0.61	14	7.3	8.9	23.0
27	1.9	0.8	0.12	0.22	33	3	27	0.49	14	7.4	8.8	22.5
28	1.2	0.7	0.10	0.18	33	3	27	0.60	14	7.4	8.7	22.0
29	1.2	1.0	0.14	0.25	30	3	28	0.39	14	7.4	8.9	23.0
30	1.3	1.2	0.27	0.20	30	3	25	0.28	14	7.5	8.9	22.7
31	1.4	0.8	0.14	0.22	30	3	25	0.25	14	7.4	8.9	22.5

NS - No sample

TABLE 2.2 (cond't): PARTICULATE REMOVAL PROFILE (1985) OCTOBER/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.1	0.8	0.10	0.20	43	3	27	0.36	14	43	8.6	17.5
2	1.1	1.1	0.12	0.19	41	3	27	0.40	14	41	8.7	17.2
3	1.0	1.1	0.12	0.18	41	3	27	0.34	14	41	8.7	17.2
4	1.0	0.9	0.10	0.18	39	3	27	0.16	14	39	8.8	16.3
5	1.1	1.2	0.12	0.20	42	4	28	0.08	14	42	8.7	16.5
6	1.1	1.5	0.11	0.20	39	4	27	-	14	39	8.8	16.0
7	1.2	1.2	0.12	0.18	39	3	28	-	14	39	8.9	15.0
8	1.2	1.3	0.14	0.19	39	3	27	0.10	14	39	8.8	15.0
9	1.2	1.1	0.17	0.25	41	3	28	0.16	14	41	8.8	14.8
10	1.2	1.2	0.10	0.18	42	3	28	-	14	42	8.7	15.1
11	1.2	1.4	0.15	0.20	31	3	28	0.18	14	31	8.9	14.0
12	1.3	1.2	0.10	0.20	35	3	27	-	14	35	8.8	13.8
13	1.3	1.2	0.14	0.23	NS	3	28	-	14	NS	8.8	13.2
14	1.2	1.0	0.15	0.20	37	3	27	0.19	14	37	8.7	13.2
15	1.2	1.0	0.12	0.20	31	3	29	0.22	14	31	8.7	13.4
16	1.4	0.9	0.10	0.20	33	3	27	0.48	14	33	8.8	13.2
17	1.2	1.2	0.10	0.18	33	3	28	0.41	14	33	8.9	12.8
18	1.1	1.2	0.12	0.20	35	3	28	0.28	14	35	8.7	12.5
19	1.1	1.3	0.16	0.20	35	3	27	-	14	35	8.8	13.0
20	1.2	1.4	0.09	0.19	33	3	28	0.12	14	33	8.7	12.9
21	1.2	1.2	0.10	0.18	33	3	28	0.45	14	33	8.7	12.4
22	1.2	1.0	0.13	0.23	37	3	27	0.59	14	37	8.9	12.1
23	1.2	1.2	0.14	0.20	38	3	27	0.57	14	38	8.8	12.3
24	1.2	1.3	0.14	0.20	36	3	27	0.63	14	36	8.7	12.1
25	1.2	1.1	0.13	0.21	36	3	27	0.63	14	36	8.8	12.2
26	1.6	1.3	0.12	0.24	31	3	28	0.44	14	31	8.9	12.4
27	1.2	1.0	0.10	0.20	31	3	29	0.44	14	31	8.8	11.9
28	2.0	0.8	0.12	0.20	31	3	30	0.50	14	31	8.8	11.0
29	2.7	1.1	0.11	0.22	NS	3	30	0.41	14	NS	8.7	10.2
30	1.8	1.6	0.10	0.25	3K	3	29	0.54	14	31	8.8	9.9
31	1.8	1.3	0.18	0.26	32	3	31	0.79	14	32	8.9	9.7

NS - No sample

TABLE 2.3: PARTICULATE REMOVAL PROFILE (1984) JANUARY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	1.2	2.3	0.54	0.54	44	5	31	0.62	17	7.2	8.8	1.0
2	1.2	2.0	0.21	0.45	44	5	30	0.72	16	7.1	8.9	1.0
3	1.2	2.1	0.10	0.38	46	4	31	0.67	14	7.3	8.8	0.5
4	1.2	2.2	0.15	0.45	46	4	29	0.78	17	7.3	8.8	0.5
5	1.5	2.1	0.14	0.42	46	4	30	1.03	16	7.3	8.5	0.5
6	1.2	1.8	0.26	0.40	48	4	30	1.13	18	7.3	8.7	0.5
7	1.2	2.3	0.15	0.44	45	4	31	0.81	15	7.1	8.6	0.5
8	1.2	2.2	0.15	0.46	42	4	32	0.78	18	7.1	8.6	0.5
9	1.2	2.1	0.10	0.42	46	4	33	0.93	15	7.1	8.7	0.5
10	1.2	1.8	0.12	0.44	45	4	33	1.17	15	7.3	8.6	0.2
11	1.3	2.2	0.18	0.38	46	4	32	0.98	15	7.0	8.6	0.2
12	1.2	1.9	0.20	0.44	46	4	32	1.14	17	7.1	8.7	0.2
13	1.2	2.0	0.12	0.42	50	4	34	1.13	15	7.2	8.7	0.2
14	1.2	1.6	0.21	0.42	50	4	32	1.08	16	7.0	9.0	0.4
15	1.1	1.6	0.12	0.40	46	5	32	1.17	14	7.1	8.7	0.4
16	1.2	1.9	0.12	0.42	49	4	32	1.06	15	7.1	8.8	0.2
17	1.2	1.8	0.12	0.34	47	4	32	1.25	15	7.0	8.8	0.2
18	1.2	2.4	0.12	0.44	47	4	32	1.11	16	7.1	8.9	0.2
19	1.2	2.0	0.12	0.40	44	4	32	1.13	16	7.2	8.9	0.5
20	1.2	1.9	0.13	0.40	47	4	32	1.22	15	7.0	8.8	0.2
21	1.3	2.2	0.11	0.47	44	4	32	1.08	17	7.1	8.6	0.2
22	1.3	2.0	0.13	0.46	44	4	32	1.22	17	7.0	8.7	0.2
23	1.2	2.0	0.14	0.39	47	4	33	1.24	16	7.1	8.8	0.5
24	1.2	2.1	0.14	0.46	46	4	32	1.19	13	7.1	8.9	0.5
25	1.3	3.1	0.12	0.47	45	5	33	1.31	13	7.2	8.7	0.5
26	1.2	2.3	0.10	0.46	49	4	33	1.24	14	7.1	8.8	0.2
27	1.2	2.1	0.17	0.35	47	4	33	1.24	13	7.1	8.8	0.2
28	1.3	1.7	0.25	0.45	46	4	32	1.24	14	7.0	8.7	0.4
29	1.3	1.4	0.22	0.40	45	4	32	1.16	14	7.0	8.9	0.5
30	1.2	2.1	0.23	0.38	45	4	32	1.23	13	7.2	8.8	0.2
31	1.4	1.8	0.23	0.44	46	4	33	1.17	13	7.1	8.7	0.2

NS - No sample

TABLE 2.3 (cont'd) PARTICULATE REMOVAL PROFILE (1984) MAY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	3.0	1.2	0.16	1.0	52	4	38	0.23	20	7.2	8.9	9.4
2	2.6	1.4	0.08	0.66	40	4	37	0.16	17	7.3	9.0	9.3
3	4.4	1.4	0.20	0.52	NS	4	39	0.58	16	7.2	8.8	9.8
4	2.9	1.2	0.18	0.80	40	4	37	0.26	12	7.3	8.8	9.2
5	2.6	1.4	0.13	0.57	39	3	37	-	13	7.2	8.9	9.5
6	2.4	1.5	0.14	0.66	40	4	37	0.13	12	7.1	8.8	10.0
7	2.2	1.3	0.12	0.62	40	4	36	0.55	12	7.0	9.0	10.0
8	2.0	1.4	0.27	0.45	43	4	37	0.34	12	7.3	9.1	10.5
9	1.9	1.2	0.22	0.42	43	4	38	-	12	7.4	8.9	10.5
10	2.0	1.4	0.30	0.61	40	4	37	-	15	7,4	8.9	10.5
11	1.9	1.3	0.17	0.60	40	4	38	-	15	7.3	9.0	11.0
12	2.9	1.2	0.29	0.58	40	4	37	-	15	7.2	8.9	10.7
13	2.0	1.3	0.23	0.72	42	4	37	-	15	7.2	8.7	11.1
14	2.2	1.2	0.18	0.72	42	4	39	0.20	15	7.4	8.8	10.8
15	2.1	1.3	0.20	0.70	42	4	37	0.22	15	7.4	8.9	11.0
16	2.2	1.7	0.07	0.93	42	4	38	-	15	7.2	8.8	11.0
17	2.2	2.7	0.29	0.90	41	4	38	0.29	15	7.2	8.8	11.0
18	2.0	0.9	0.21	0.62	41	4	38	0.23	15	7.4	8.6	11.4
19	2.0	1.1	0.11	0.64	36	4	39	-	15	7.3	8.7	11.6
20	1.6	1.2	0.16	0.55	36	4	38	-	15	7.2	8.6	12.0
21	1.6	1.4	0.16	0.60	36	4	39	0.12	15	7.2	8.8	12.2
22	1.6	1.1	0.16	0.56	36	4	39	0.38	15	7.3	8.7	13.1
23	1.6	1.0	0.08	0.89	35	4	39	0.31	15	7.4	8.6	13.5
24	1.5	1.0	0.08	0.64	35	4	41	0.45	15	7.3	8.5	13.8
25	1.6	0.8	0.10	0.96	32	4	39	0.29	15	7.5	8.6	14.1
26	1.8	1.0	0.12	1.8	32	5	39	0.28	15	7.2	8.8	13.8
27	2.0	1.0	0.10	0.72	37	4	39	0.40	15	7.3	8.7	14.2
28	2.0	1.0	0.08	0.81	37	4	39	0.30	15	7.4	8.8	14.4
29	2.5	1.2	0.18	0.55	37	4	38	0.12	14	7.3	8.8	13.8
30	3.2	1.8	0.13	0.42	37	4	40	0.39	14	7.4	8.7	13.6
31	2.4	2.2	0.10	0.42	37	4	35	0.19	13	7.2	8.9	13.4

NS - No sample

TABLE 2.3 (cont'd): PARTICULATE REMOVAL PROFILE (1984) JULY/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	2.5	1.8	0.12	0.35	43	4	21	0.46	12	7.3	8.7	20.5
2	2.4	2.1	0.20	0.28	44	4	23	0.58	11	7.2	8.8	20.8
3	2.4	1.6	0.10	0.27	39	4	23	0.67	11	7.1	8.8	21.5
4	2.3	1.6	0.18	0.27	44	4	23	0.64	12	7.1	9.0	21.5
5	2.6	2.0	0.18	0.36	41	4	23	0.61	12	7.2	9.1	21.5
6	2.2	1.7	0.16	0.28	41	4	23	0.57	13	7.1	8.9	21.5
7	2.5	1.5	0.27	0.48	40	5	23	0.33	13	7.2	9.2	20.3
8	2.3	1.8	0.51	0.23	40	5	23	0.44	13	7.0	8.8	20.3
9	2.3	2.1	0.28	0.37	39	4	23	0.74	13	7.2	9.0	20.0
10	2.2	1.5	0.22	0.37	42	4	24	0.98	13	7.2	9.0	21.0
11	2.2	1.4	0.10	0.30	41	4	25	0.79	13	7.1	9.4	20.5
12	3.7	1.4	0.12	0.32	44	4	25	0.72	13	7.1	8.8	20.5
13	2.2	1.8	0.15	0.28	41	4	25	0.44	13	7.1	8.8	21.2
14	2.2	1.8	0.18	0.32	35	4	25	0.51	13	7.2	8.6	21.5
15	2.4	1.9	0.22	0.28	35	4	25	0.29	13	7.3	8.8	21.5
16	2.7	1.7	0.16	0.32	35	4	26	0.50	13	7.4	8.8	21.2
17	2.4	1.7	0.12	0.34	35	4	25	0.58	13	7.2	8.9	22.0
18	3.4	2.0	0.18	0.34	36	4	26	0.26	13	7.3	8.8	21.8
19	2.5	1.3	0.10	0.30	38	4	27	0.35	13	7.2	9.0	22.5
20	3.1	1.3	0.12	0.34	38	4	27	0.50	13	7.2	8.9	22.1
21	2.6	1.2	0.11	0.26	40	4	27	0.47	13	7.2	8.9	22.2
22	2.4	1.2	0.16	0.35	40	4	27	0.51	13	7.2	8.9	22.5
23	2.2	1.2	0.08	0.30	37	4	29	0.71	13	7.2	8.8	23.0
24	2.4	1.0	0.12	0.32	39	4	27	0.65	13	7.3	9.0	22.5
25	3.4	1.2	0.12	0.32	38	4	27	0.64	13	7.2	8.8	22.1
26	2.4	1.8	0.14	0.32	36	4	28	0.48	13	7.2	8.8	22.1
27	2.3	1.2	0.10	0.32	40	4	28	0.41	13	7.2	8.7	22.0
28	2.5	1.3	0.17	0.35	40	4	27	0.29	13	7.2	8.8	21.8
29	2.1	1.2	0.16	0.32	40	4	27	0.31	13	7.2	8.7	22.0
30	1.8	1.0	0.11	0.26	39	4	27	0.58	13	7.2	8.7	22.2
31	1.9	1.1	0.12	0.24	39	4	26	0.63	13	7.2	8.9	22.2

NS - No sample

TABLE 2.3 (cont'd): PARTICULATE REMOVAL PROFILE (1984) OCTOBER/LEMIEUX ISLAND

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT	COAG. AID	LIME	pH		TEMP (°C)
	Raw	Set	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	Raw	Treat.	
1	2.0	1.2	0.12	0.30	40	4	30	0.34	10	7.2	8.8	15.8
2	1.8	1.2	0.08	0.37	39	4	30	0.61	10	7.1	8.8	15.6
3	2.0	0.8	0.10	0.30	39	4	29	0.53	11	7.2	8.8	15.2
4	2.2	1.1	0.10	0.30	42	4	31	0.66	11	7.3	8.9	14.4
5	2.5	1.3	0.12	0.22	42	4	30	0.47	13	7.3	9.0	13.5
6	2.4	1.5	0.12	0.30	42	4	30	-	12	7.4	8.7	12.8
7	2.2	1.5	0.12	0.30	42	4	29	0.10	12	7.4	8.6	12.5
8	2.0	1.2	0.08	0.28	42	4	29	0.29	12	7.0	8.5	12.8
9	1.9	0.9	0.10	0.20	42	4	29	0.34	12	7.3	8.8	12.4
10	2.0	1.3	0.10	0.32	42	4	30	0.73	11	7.2	8.9	13.3
11	1.8	1.2	0.08	0.32	42	4	30	0.46	11	7.2	8.7	13.4
12	1.6	0.9	0.08	0.32	42	4	29	0.60	12	7.3	8.8	13.2
13	1.¢	1.4	0.14	0.30	43	4	30	0.18	12	7.2	8.7	13.0
14	1.5	1.2	0.16	0.32	43	4	29	-	12	7.2	8.9	13.1
15	1.7	1.0	0.17	0.36	45	4	29	0.66	11	7.3	8.7	12.4
16	1.6	1.0	0.09	0.30	45	4	30	0.69	12	7.3	8.7	12.2
17	1.7	1.5	0.12	0.35	45	4	30	0.51	12	7.1	8.7	12.4
18	1.7	1.5	0.15	0.30	41	4	29	0.36	11	7.2	8.8	12.1
19	1.8	1.1	0.14	0.38	41	4	30	0.34	11	7.2	8.9	12.1
20	1.8	1.4	0.09	0.34	41	4	30	0.25	11	7.3	8.8	12.3
21	1.7	1.1	0.09	0.31	41	4	30	0.12	11	7.2	8.7	12.2
22	1.7	1.0	0.12	0.32	41	4	30	0.35	12	7.3	8.9	12.0
23	1.8	1.3	0.09	0.21	42	4	30	0.40	11	7.3	8.7	11.9
24	1.7	1.3	0.11	0.28	42	4	30	0.68	11	7.2	8.7	11.8
25	1.8	1.4	0.11	0.30	42	3	30	0.49	11	7.2	8.8	11.5
26	1.7	1.6	0.09	0.30	42	4	30	0.44	11	7.4	8.8	11.5
27	1.8	1.3	0.10	0.32	43	4	30	0.10	12	7.2	8.9	11.7
28	2.0	1.1	0.10	0.30	43	4	30	0.33	11	7.3	8.9	12.1
29	1.8	1.1	0.10	0.28	43	4	29	0.40	10	7.3	8.9	12.4
30	2.0	1.2	0.08	0.27	42	4	30	0.29	11	7.3	8.8	11.8
31	1.7	1.0	0.08	0.28	43	4	30	0.73	11	7.3	8.9	11.6

NS - No sample

TABLE 3.0: DISINFECTION SUMMARY FOR LEMIEUX ISLAND

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl_2 Demand	1.14	0.87	1.00	0.29	0.00	0.14	1.10	0.86	0.88	0.46	0.00	0.01	1.06	0.56	0.74	0.34	0.00	0.13
	Cl_2 Dosage	1.20	1.00	1.10	1.07	0.77	0.94	1.20	1.00	1.00	1.72	0.59	0.79	1.20	0.80	0.90	1.05	0.74	0.87
	NH_3	0.21	0.71	0.71	0.70	0.20	0.20	0.35	0.35	0.35	0.17	0.17	0.17	-	-	-	-	-	-
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.13	0.06	0.10	0.90	0.90	0.90	0.21	0.09	0.12	0.90	0.90	0.90	0.25	0.10	0.16	0.90	0.90	0.90
	F-Dosage	-	-	-	0.92	0.71	0.80	-	-	-	0.94	0.79	0.84	-	-	-	1.01	0.79	0.90
	F-Res.	-	-	-	1.00	0.90	0.95	-	-	-	1.00	0.90	0.95	-	-	-	1.05	0.90	1.00
FEB	Cl_2 Demand	0.90	0.66	0.77	0.35	0.00	0.14	1.00	0.74	0.85	0.40	0.00	0.02	0.80	0.70	0.75	0.37	0.00	0.08
	Cl_2 Dosage	1.00	0.80	0.90	1.11	0.61	0.91	1.00	1.00	1.00	1.10	0.57	0.77	1.00	1.00	1.00	1.05	0.58	0.73
	NH_3	0.88	0.88	0.88	0.51	0.51	0.51	0.20	0.20	0.20	0.13	0.13	0.13	0.20	0.20	0.20	0.12	0.12	0.12
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.20	0.08	0.13	0.90	0.90	0.90	0.26	0.09	0.15	0.90	0.90	0.90	0.30	0.20	0.25	0.90	0.90	0.90
	F-Dosage	-	-	-	0.86	0.67	0.77	-	-	-	0.97	0.80	0.88	-	-	-	0.89	0.79	0.82
	F-Res.	-	-	-	1.05	0.95	1.00	-	-	-	1.00	0.90	0.95	-	-	-	1.00	0.90	0.95
MAR	Cl_2 Demand	0.81	0.57	0.63	0.33	0.00	0.17	0.87	0.69	0.80	0.72	0.00	0.16	0.80	0.69	0.74	0.32	0.01	0.16
	Cl_2 Dosage	1.00	0.80	0.80	1.07	0.68	0.90	1.00	1.00	1.00	1.35	0.64	0.86	1.00	1.00	1.00	0.97	0.68	0.80
	NH_3	-	-	-	-	-	-	0.06	0.06	0.06	0.08	0.08	0.08	0.07	0.07	0.07	0.05	0.05	0.05
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.27	0.10	0.17	0.90	0.90	0.90	0.31	0.13	0.20	0.90	0.90	0.90	0.31	0.20	0.26	0.90	0.90	0.90
	F-Dosage	-	-	-	0.91	0.50	0.76	-	-	-	0.95	0.63	0.84	-	-	-	0.97	0.13	0.80
	F-Res.	-	-	-	1.05	0.85	0.90	-	-	-	1.05	0.90	1.00	-	-	-	1.00	0.55	0.95

TABLE 3.0 (cont'd): DISINFECTION SUMMARY FOR LEMIEUX ISLAND

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
APR	Cl_2 Demand	1.07	0.61	0.87	0.48	0.00	0.18	0.87	0.74	0.83	0.28	0.00	0.08	0.88	0.70	0.78	0.46	0.00	0.13
	Cl_2 Dosage	1.20	0.80	1.00	1.25	0.52	0.95	1.00	1.00	1.00	1.03	0.56	0.81	1.00	1.00	1.00	1.08	0.58	0.81
	NH_3	-	-	-	-	-	-	0.08	0.08	0.08	0.01	0.01	0.01	0.66	0.66	0.66	.003	.003	.003
	O_2	2.7	2.7	2.7	14.0	14.0	14.0	14.0	14.0	14.0	30.0	30.0	30.0	11.0	11.0	11.0	29.0	29.0	29.0
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.25	0.07	0.13	0.90	0.90	0.90	0.26	0.13	0.17	0.90	0.90	0.90	0.30	0.12	0.22	0.90	0.90	0.90
	F-Dosage	-	-	-	0.93	0.34	0.80	-	-	-	0.84	0.71	0.81	-	-	-	0.95	0.73	0.85
	F-Res.	-	-	-	1.05	0.05	0.40	-	-	-	1.05	0.90	0.95	-	-	-	1.00	0.90	0.95
MAY	Cl_2 Demand	1.36	0.81	0.96	0.70	0.00	0.29	1.12	0.86	1.00	0.32	0.00	0.03	1.12	0.78	0.96	0.59	0.08	0.20
	Cl_2 Dosage	1.40	1.00	1.10	1.44	0.60	1.05	1.20	1.00	1.10	1.11	0.62	0.83	1.20	1.00	1.10	1.34	0.80	0.96
	NH_3	-	-	-	-	-	-	0.34	0.34	0.34	0.38	0.38	0.38	0.12	0.12	0.12	0.13	0.13	0.13
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.25	0.04	0.14	0.90	0.90	0.90	0.15	0.07	0.10	0.90	0.90	0.90	0.22	0.05	0.14	0.90	0.90	0.90
	F-Dosage	-	-	-	1.00	0.52	0.86	-	-	-	0.86	0.74	0.83	-	-	-	0.99	0.75	0.86
	F-Res.	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.90	0.95	-	-	-	1.10	0.90	1.00
JUN	Cl_2 Demand	2.30	1.46	2.02	0.36	0.00	0.17	1.75	1.06	1.32	0.38	0.00	0.07	1.75	1.08	1.53	0.63	0.07	0.23
	Cl_2 Dosage	2.40	1.50	2.10	1.24	0.81	1.01	1.80	1.20	1.40	1.20	0.69	0.89	1.80	1.20	1.60	1.47	0.91	1.06
	NH_3	-	-	-	-	-	-	0.43	0.43	0.43	0.28	0.28	0.28	0.14	0.14	0.14	0.14	0.14	0.14
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.14	0.04	0.08	1.00	0.90	0.92	0.14	0.04	0.08	0.90	0.90	0.90	0.12	0.04	0.07	0.90	0.90	0.90
	F-Dosage	-	-	-	0.98	0.79	0.91	-	-	-	0.93	0.79	0.83	-	-	-	0.99	0.74	0.88
	F-Res.	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.90	0.95	-	-	-	1.10	0.90	1.00

TABLE 3.0 (cont'd): DISINFECTION SUMMARY FOR LEMIEUX ISLAND

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JUL	Cl_2 Demand	3.79	2.28	2.88	0.83	0.00	0.28	1.95	1.72	1.84	0.29	0.00	0.04	1.76	1.68	1.73	0.56	0.03	0.28
	Cl_2 Dosage	4.00	2.40	3.10	1.79	0.56	1.20	2.00	1.80	1.90	1.12	0.58	0.88	1.80	1.80	1.80	1.34	0.86	1.11
	NH_3	-	-	-	-	-	-	-	-	-	-	-	-	0.31	0.31	0.31	0.24	0.24	0.24
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.58	0.08	0.22	1.40	1.00	1.14	0.08	0.03	0.06	0.90	0.90	0.90	0.12	0.04	0.07	0.90	0.90	0.90
	F-Dosage	-	-	-	0.96	0.75	0.90	-	-	-	0.99	0.78	0.86	-	-	-	0.94	0.77	0.85
	F-Res.	-	-	-	1.05	0.95	0.98	-	-	-	1.00	0.95	1.00	-	-	-	1.05	0.90	1.00
AUG	Cl_2 Demand	3.55	2.69	3.11	1.05	0.00	0.36	1.95	1.48	1.83	0.34	0.00	0.16	1.96	1.72	1.74	0.48	0.04	0.24
	Cl_2 Dosage	3.80	3.00	3.40	1.97	0.91	1.47	2.00	1.80	1.90	1.16	0.82	0.99	2.00	1.80	1.80	1.30	0.89	1.08
	NH_3	-	-	-	-	-	-	-	-	-	-	-	-	0.74	0.74	0.74	0.65	0.65	0.65
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.64	0.18	0.29	1.40	1.40	1.40	0.10	0.04	0.07	0.90	0.90	0.90	0.08	0.04	0.06	0.91	0.90	0.90
	F-Dosage	-	-	-	0.98	0.70	0.90	-	-	-	1.00	0.93	0.96	-	-	-	0.91	0.00	0.82
	F-Res.	-	-	-	1.05	0.90	1.00	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.05	0.81
SEP	Cl_2 Demand	2.75	2.12	2.45	2.15	0.00	0.27	1.94	1.73	1.74	0.18	0.00	0.00	1.95	1.90	1.94	0.62	0.00	0.29
	Cl_2 Dosage	3.00	2.40	2.70	1.96	0.93	1.42	2.00	1.80	1.80	1.03	0.66	0.84	2.00	2.00	2.00	1.46	0.72	1.13
	NH_3	-	-	-	-	-	-	0.36	0.36	0.36	0.42	0.42	0.42	.276	.276	.276	0.241	0.241	0.241
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.40	0.15	0.25	1.40	1.40	1.40	0.07	0.05	0.06	0.90	0.90	0.90	0.10	0.05	0.06	0.90	0.90	0.90
	F-Dosage	-	-	-	0.95	0.74	0.88	-	-	-	0.97	0.89	0.92	-	-	-	1.01	0.83	0.90
	F-Res.	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.95	1.00

TABLE 3.0 (cont'd): DISINFECTION SUMMARY FOR LEMIEUX ISLAND

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
OCT	Cl_2 Demand	2.44	2.24	2.37	0.96	0.00	0.32	1.95	1.92	1.93	0.36	0.00	0.03	1.94	1.88	1.91	0.83	0.04	0.39
	Cl_2 Dosage	2.60	2.60	2.60	2.01	0.82	1.49	2.00	2.00	2.00	1.18	0.60	0.86	2.00	2.00	2.00	1.63	0.85	1.20
	NH_3	0.22	0.22	0.22	-	-	-	-	-	-	-	-	-	0.17	0.17	0.17	0.11	0.11	0.11
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.36	0.16	0.23	1.40	1.40	1.40	0.08	0.05	0.07	0.90	0.90	0.90	0.12	0.06	0.09	0.90	0.90	0.90
	F-Dosage	-	-	-	0.93	0.00	0.56	-	-	-	0.93	0.85	0.90	-	-	-	0.96	0.78	0.88
	F-Res.	-	-	-	1.05	0.05	0.65	-	-	-	1.05	0.95	1.00	-	-	-	1.05	0.95	1.00
NOV	Cl_2 Demand	2.38	1.62	1.92	0.79	0.00	0.36	1.83	1.13	1.44	0.47	0.00	0.03	1.54	1.49	1.52	0.52	0.10	0.30
	Cl_2 Dosage	2.60	2.00	2.20	1.90	0.86	1.48	1.90	1.20	1.50	1.31	0.62	0.87	1.60	1.60	1.60	1.34	0.94	1.12
	NH_3	-	-	-	-	-	-	0.29	0.29	0.29	0.22	0.22	0.22	0.29	0.29	0.29	0.23	0.23	0.23
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.38	0.20	0.28	1.40	1.40	1.40	0.08	0.05	0.06	0.90	0.90	0.90	0.11	0.06	0.08	0.90	0.90	0.90
	F-Dosage	-	-	-	0.92	0.00	0.73	-	-	-	0.91	0.75	0.84	-	-	-	0.92	0.74	0.81
	F-Res.	-	-	-	1.05	0.05	0.75	-	-	-	1.05	0.85	0.95	-	-	-	1.00	0.60	0.85
DEC	Cl_2 Demand	1.72	0.70	1.33	0.59	0.09	0.33	1.15	1.10	1.13	0.26	0.00	0.09	1.52	0.80	1.27	0.39	0.00	0.15
	Cl_2 Dosage	2.00	1.00	1.70	1.75	1.02	1.36	1.20	1.20	1.20	1.09	0.62	0.92	1.60	1.20	1.40	1.21	0.67	0.92
	NH_3	-	-	-	-	-	-	0.21	0.21	0.21	0.04	0.04	0.04	0.25	0.25	0.25	0.19	0.19	0.19
	Cl_2 Res.(Free)																		
	Cl_2 Res.(Comb)																		
	Cl_2 Res.(Total)	0.70	0.21	0.37	1.40	1.40	1.40	0.10	0.05	0.07	0.90	0.90	0.90	0.26	0.08	0.13	0.90	0.90	0.90
	F-Dosage	-	-	-	0.88	0.00	0.63	-	-	-	0.99	0.76	0.84	-	-	-	0.93	0.75	0.83
	F-Res.	-	-	-	1.05	0.10	0.95	-	-	-	1.05	0.95	1.00	-	-	-	1.00	0.85	0.95

TABLE 3.1: DISINFECTION PROFILE FOR LEMIEUX ISLAND/JANUARY 1986

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.14	1.20	-		0.19	-	0.24	(0.01)	0.83	-	-	0.87	<0.01	0.92	0.71	1.00
2	1.13	1.20	-		0.12	0.06	0.23	0.14	0.97	-	-	0.82	0.06	0.92	0.80	1.00
3	1.13	1.20	-		0.09	<0.01	0.23	0.16	0.99	-	-	0.91	<0.01	1.0	0.81	0.95
4	1.12	1.20	-		0.14	<0.01	0.24	0.05	0.87	-	-	0.87	0.02	0.91	0.75	0.95
5	1.13	1.20	-		0.23	<0.01	0.32	(0.06)	0.77	-	-	0.88	<0.01	0.90	0.75	0.95
6	1.13	1.20	-		0.12	0.08	0.28	0.22	1.05	-	-	0.80	0.05	0.88	0.77	1.00
7	1.13	1.20	-		0.13	0.09	0.34	0.16	0.99	-	-	0.84	0.04	0.90	0.80	0.95
8	1.12	1.20	-		0.14	0.11	0.32	0.16	0.98	-	-	0.82	0.06	0.90	0.83	1.00
9	1.10	1.20	-		0.12	0.06	0.31	0.15	0.95	-	-	0.81	0.08	0.91	0.86	1.00
10	1.13	1.20	-		0.11	0.06	0.29	0.01	0.84	-	-	0.80	0.06	0.88	0.85	1.00
11	1.10	1.20	-		0.12	<0.01	0.33	0.13	0.93	-	-	0.85	<0.01	0.90	0.77	0.95
12	1.08	1.20	-		0.19	<0.01	0.33	0.12	0.90	-	-	0.88	<0.01	0.92	0.81	1.00
13	1.09	1.20	-		0.14	0.08	0.40	0.12	0.91	-	-	0.84	0.06	0.92	0.81	1.00
14	0.92	1.00	-		0.10	0.06	0.22	0.11	0.93	-	-	0.81	0.08	0.91	0.71	1.00
15	0.90	1.00	0.21		0.12	0.08	0.30	0.14	0.94	0.20	-	0.78	0.10	0.92	0.84	0.95
16	0.90	1.00	-		0.12	0.10	0.30	0.18	0.98	-	-	0.65	0.18	0.89	0.90	0.95
17	0.88	1.00	-		0.11	0.09	0.31	0.22	1.00	-	-	0.65	0.20	0.85	0.92	1.00
18	0.90	1.00	-		0.10	0.07	0.22	(0.01)	0.79	-	-	0.58	0.28	0.84	0.82	1.00
19	0.91	1.00	-		0.08	0.08	0.26	0.22	1.03	-	-	0.52	0.30	0.88	0.84	0.95
20	0.93	1.00	-		0.14	0.06	0.26	0.06	0.89	-	-	0.55	0.30	0.89	0.84	0.95
21	0.93	1.00	-		0.06	0.05	-	0.23	1.06	-	-	0.46	0.36	0.91	0.82	NS
22	0.88	1.00	-		0.10	0.06	0.23	0.22	1.00	-	-	0.55	0.30	0.90	0.85	0.90
23	0.88	1.00	-		0.14	0.07	0.25	0.29	1.00	-	-	0.68	0.20	0.91	0.84	0.95
24	0.88	1.00	-		0.16	0.94	0.32	0.16	0.94	-	-	0.48	0.37	0.90	0.75	0.90
25	0.87	1.00	-		0.27	-	0.43	0.16	0.93	-	-	0.70	0.12	0.88	0.86	0.90
26	0.88	1.00	-		0.10	0.12	0.36	0.15	0.93	-	-	0.64	-	0.82	0.75	1.00
27	0.88	1.00	-		0.13	0.12	0.36	0.28	1.06	-	-	0.68	-	0.98	0.83	1.00
28	0.88	1.00	-		0.08	0.10	0.28	0.06	0.84	-	-	0.56	0.14	0.85	0.83	0.95
29	0.88	1.00	-		0.12	0.08	0.24	0.06	0.84	-	-	0.64	0.14	0.87	0.75	1.00
30	0.88	1.00	-		0.14	0.11	0.31	0.18	0.92	-	-	0.52	0.20	0.85	0.75	1.00
31	0.87	1.00	-		0.08	0.07	0.26	0.19	0.96	-	-	0.88	0.21	0.89	0.78	1.00

TABLE 3.1 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/MAY 1986

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.03	1.20	-		0.08	0.07	0.34	0.91	0.92	-	-	0.58	0.22	0.87	0.87	1.05
2	0.97	1.20	-		0.12	0.07	0.34	0.38	1.05	-	-	0.50	0.20	0.75	0.91	1.00
3	0.85	1.10	-		0.11	0.07	0.34	0.27	0.92	-	-	0.62	0.21	0.87	0.86	1.05
4	0.83	1.00	-		0.10	0.06	0.26	0.06	0.79	-	-	0.64	0.20	0.88	0.84	0.95
5	0.86	1.00	-		0.10	0.06	0.23	0.42	1.18	-	-	0.62	0.21	0.89	0.76	1.00
6	0.82	1.00	-		0.08	0.07	0.26	0.52	1.24	-	-	0.74	0.08	0.89	0.52	1.00
7	0.84	1.00	-		0.10	0.06	0.24	0.70	1.44	-	-	0.72	0.22	0.89	0.85	1.00
8	0.88	1.00	-		0.10	0.07	0.26	0.16	0.94	-	-	0.66	0.20	0.87	0.88	0.95
9	0.88	1.00	-		0.09	0.06	0.23	0.63	1.41	-	83	0.64	0.22	0.90	0.84	1.00
10	0.81	1.00	-		0.11	0.03	0.35	0.44	1.15	-	-	0.76	<0.01	0.90	0.79	1.05
11	0.82	1.00	-		0.21	0.02	0.32	0.31	1.03	-	-	0.83	<0.01	0.88	0.74	1.00
12	0.88	1.00	-		0.10	0.06	0.25	0.26	1.04	-	-	0.68	0.18	0.89	0.76	0.95
13	0.85	1.00	-		0.10	0.08	0.29	0.26	1.01	-	-	0.66	0.20	0.89	0.72	0.95
14	0.85	1.00	-		0.14	0.10	0.29	0.20	0.95	-	-	0.60	0.20	0.85	0.75	0.95
15	1.12	1.20	-		0.10	0.04	0.21	0.15	0.97	-	-	0.58	0.18	0.80	0.83	1.00
16	1.05	1.20	-		0.14	0.06	0.34	0.15	0.90	-	-	0.73	0.14	0.89	0.84	0.95
17	1.05	1.20	-		0.11	0.06	0.33	0.33	1.08	-	-	0.72	0.13	0.88	0.86	0.95
18	1.09	1.20	-		0.10	0.06	0.34	0.51	1.30	-	-	0.71	0.14	0.88	0.93	0.95
19	1.05	1.20	-		0.10	0.06	0.36	0.45	1.20	-	-	0.70	0.15	0.87	0.88	0.95
20	1.04	1.20	-		0.14	<0.01	0.38	0.47	1.21	-	-	0.83	<0.01	0.88	0.96	1.00
21	1.09	1.20	-		0.10	0.06	0.32	0.29	1.08	-	-	0.65	0.12	0.87	0.89	1.00
22	1.06	1.20	-		0.15	0.10	0.35	0.19	0.95	-	-	0.68	0.15	0.88	0.92	1.00
23	1.06	1.20	-		0.12	0.06	0.33	0.37	1.13	-	-	0.64	0.20	0.80	0.98	0.95
24	1.04	1.20	-		0.26	0.05	0.39	0.46	1.20	-	-	0.90	0.01	0.91	1.00	0.95
25	1.04	1.20	-		0.21	0.02	0.33	0.51	1.25	-	-	0.90	0.01	0.92	0.98	0.95
26	1.03	1.20	-		0.08	0.08	0.32	(0.13)	0.60	-	-	0.66	0.14	0.89	0.95	1.00
27	1.06	1.20	-		0.10	0.08	0.30	0.22	0.98	-	-	0.65	0.15	0.85	0.92	1.00
28	1.12	1.20	-		0.08	0.06	0.24	0.21	1.03	-	-	0.64	0.16	0.88	0.95	0.95
29	1.26	1.30	-		0.07	0.05	0.21	(0.08)	0.78	-	-	0.64	0.18	0.89	0.92	0.95
30	1.35	1.40	-		0.05	0.08	0.23	(0.02)	0.83	-	-	0.74	0.10	0.89	0.92	1.00
31	1.36	1.40	-		0.07	<0.01	0.24	0.32	1.18	-	-	0.72	0.12	0.88	0.92	1.00

TABLE 3.1 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/JULY 1986

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	2.28	2.40	-		0.74	0.03	0.96	(0.08)	0.80	-	-	0.96	<0.01	1.02	0.96	1.05
2	2.30	2.40	-		0.76	0.10	0.98	0.35	1.25	-	-	0.95	0.05	1.02	0.88	1.00
3	2.31	2.40	-		0.98	0.08	1.33	(0.08)	0.83	-	-	0.88	0.07	0.99	0.93	0.95
4	2.30	2.40	-		0.84	0.12	1.08	0.65	1.55	-	-	0.90	0.07	1.00	0.95	1.00
5	2.32	2.40	-		0.86	0.08	0.97	0.54	1.46	-	-	0.88	0.08	1.03	0.94	0.95
6	2.30	2.40	-		0.88	0.10	1.06	0.38	1.28	-	-	0.90	0.08	1.02	0.91	0.95
7	2.42	2.50	-		0.92	0.14	1.16	(0.14)	0.78	-	-	0.85	0.10	0.98	0.86	0.95
8	2.50	2.60	-		0.54	0.06	0.82	(0.01)	0.89	-	-	0.85	0.08	0.98	0.87	1.00
9	2.70	2.80	-		0.48	0.18	0.86	0.13	1.03	-	-	0.86	0.08	0.98	0.94	0.95
10	3.51	3.60	-		1.12	0.10	1.49	(0.05)	0.86	-	-	0.87	0.06	0.98	0.94	0.95
11	3.79	4.00	-		1.86	0.26	2.25	(0.23)	0.56	-	-	0.82	0.08	0.99	0.88	1.00
12	3.50	3.90	-		2.68	0.04	3.02	0.40	1.00	-	-	0.86	0.06	1.10	0.84	1.00
13	3.53	3.80	-		3.04	0.04	3.14	0.27	1.00	-	-	0.83	0.02	1.00	0.86	1.05
14	2.82	3.40	9.0		1.32	0.16	1.72	0.83	1.25	-	23.0	0.88	0.10	0.89	0.88	1.00
15	3.00	3.20	-		1.34	0.18	1.66	0.37	1.17	-	-	0.88	0.08	1.00	0.89	1.00
16	2.94	3.20	-		1.34	0.17	1.68	0.46	1.20	-	-	0.88	0.08	0.89	0.83	0.95
17	2.78	3.20	-		1.53	0.18	1.82	0.49	1.17	-	-	1.02	0.10	1.18	0.75	0.95
18	2.98	3.20	-		1.54	0.16	1.72	(0.18)	0.80	-	-	1.05	0.10	1.22	0.96	1.00
19	2.89	3.20	-		1.65	<0.01	1.80	0.35	1.24	-	-	1.05	<0.01	1.20	0.89	1.00
20	2.90	3.20	-		1.75	<0.01	1.90	0.43	1.33	-	-	1.09	<0.01	1.25	0.90	1.00
21	2.95	3.20	-		1.50	0.05	1.65	0.47	1.42	-	-	1.08	0.01	1.19	0.87	1.00
22	2.95	3.20	-		1.55	0.09	1.68	0.58	1.53	-	-	1.08	0.08	1.18	0.88	1.00
23	2.95	3.20	-		1.28	0.10	1.68	0.50	1.45	-	-	1.05	0.08	1.15	0.91	1.00
24	2.96	3.20	-		1.28	0.10	1.58	0.47	1.43	-	-	1.10	0.05	1.20	0.95	1.00
25	2.95	3.20	-		1.84	0.18	2.36	0.16	1.31	-	-	1.26	0.07	1.38	0.90	1.00
26	2.97	3.20	-		1.03	0.07	1.42	0.22	1.39	-	-	1.20	0.12	1.35	0.96	0.95
27	2.96	3.20	-		1.48	-	1.72	0.33	1.49	-	-	1.28	0.07	1.39	0.86	0.95
28	2.97	3.20	-		1.04	0.10	1.48	0.29	1.46	-	-	1.28	0.07	1.37	0.88	0.95
29	3.00	3.20	-		1.36	0.12	1.75	0.59	1.79	-	-	1.30	0.06	1.39	0.89	0.95
30	3.16	3.40	-		1.41	0.10	1.63	0.09	1.25	-	-	1.32	0.06	1.42	0.84	0.95
31	3.15	3.40	-		1.48	0.12	1.72	(0.15)	1.00	-	-	1.34	0.06	1.43	0.88	0.95

TABLE 3.1 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/OCTOBER 1986

DATE	PRE CHLORINATION								POST-CHLORINATION						FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	2.44	2.60	-		0.76	0.14	0.94	(0.15)	1.09	-	-	-	-	1.30	0.85	1.00
2	2.40	2.60	-		1.06	0.14	1.20	0.64	1.84	-	-	1.24	0.08	1.38	0.93	0.95
3	2.30	2.60	-		1.12	0.14	1.36	(0.37)	.82	-	-	1.24	0.08	1.37	0.89	0.95
4	2.41	2.60	-		0.90	<0.01	1.16	0.49	1.70	-	-	1.40	<0.01	1.42	0.92	1.00
5	2.40	2.60	-		1.00	<0.01	1.22	0.43	1.63	-	-	1.28	<0.01	1.43	0.92	1.00
6	2.25	2.60	0.22		1.06	0.14	1.28	0.96	2.01	0.22	-	1.30	0.08	1.43	0.90	1.05
7	2.33	2.60	-		1.03	0.12	1.21	0.41	1.54	-	-	1.28	0.10	1.42	0.90	1.05
8	2.41	2.60	-		1.06	0.10	1.23	(0.13)	1.08	-	-	1.24	0.10	1.38	0.88	1.00
9	2.33	2.60	-		1.12	0.10	1.30	0.68	1.81	-	-	1.28	0.08	1.39	0.88	0.95
10	2.42	2.60	-		0.88	0.08	1.16	(0.09)	1.13	-	-	1.30	0.10	1.43	0.89	0.95
11	2.40	2.60	-		0.90	0.07	1.18	0.60	1.80	-	-	1.32	0.08	1.41	0.84	0.95
12	2.39	2.60	-		0.94	0.06	1.08	0.64	1.83	-	-	1.36	0.01	1.42	0.85	1.05
13	2.35	2.60	-		0.95	0.02	1.21	0.71	1.86	-	-	1.33	<0.01	1.38	0.81	1.05
14	2.24	2.60	-		0.93	0.10	1.18	0.44	1.48	-	-	1.25	0.10	1.40	0.84	1.00
15	2.40	2.60	-		0.96	0.08	1.22	0.03	1.23	-	-	1.28	0.03	1.43	0.85	0.95
16	2.35	2.60	-		1.21	0.14	1.53	0.26	1.41	-	-	1.30	0.07	1.42	0.83	0.95
17	2.33	2.60	-		1.08	0.10	1.36	0.07	1.20	-	-	1.32	0.08	1.44	0.84	1.00
18	2.40	2.60	-		0.95	<0.01	1.15	0.12	1.32	-	-	1.28	<0.01	1.40	0.84	1.00
19	2.42	2.60	-		0.95	<0.01	1.20	0.22	1.44	-	-	1.28	<0.01	1.40	0.84	0.95
20	2.32	2.60	-		0.87	0.08	1.18	0.68	1.80	-	-	1.26	0.08	1.39	0.83	0.40
21	2.33	2.60	-		0.78	0.16	1.10	0.42	1.55	-	-	1.29	0.09	1.42	-	0.15
22	2.34	2.60	-		0.72	0.14	1.12	0.23	1.37	-	-	1.30	0.10	1.43	-	0.10
23	2.32	2.60	-		0.78	0.10	1.14	0.38	1.50	-	-	1.32	0.08	1.43	-	0.10
24	2.35	2.60	-		0.86	0.16	1.18	0.47	1.62	-	-	1.32	0.06	1.42	-	0.05
25	2.42	2.60	-		0.72	0.10	1.08	(0.12)	1.10	-	-	1.34	0.05	1.42	-	0.05
26	2.44	2.60	-		0.82	0.12	1.18	0.50	1.74	-	-	1.32	0.10	1.45	-	0.10
27	2.39	2.60	-		0.84	0.10	1.16	0.58	1.77	-	-	1.34	0.08	1.45	-	0.10
28	2.40	2.60	-		0.92	0.08	1.18	0.30	1.50	-	17.2	1.32	0.08	1.44	-	0.05
29	2.37	2.60	-		0.98	0.10	1.22	0.08	1.25	-	-	1.30	0.08	1.42	-	0.05
30	2.37	2.60	-		0.95	0.18	1.24	0.20	1.37	-	-	1.32	0.10	1.45	-	0.10
31	2.33	2.60	-		1.05	0.07	1.29	0.45	1.58	-	-	1.50	0.05	1.66	-	0.05

TABLE 3.2: DISINFECTION PROFILE FOR LEMIEUX ISLAND/JANUARY 1985

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.10	1.20	-		0.13	0.08	0.31	(0.03)	0.77	-	-	0.58	0.10	0.88	0.84	0.90
2	1.07	1.20	-		0.14	0.06	0.32	(0.04)	0.73	-	-	0.52	0.31	0.89	0.83	0.95
3	1.08	1.20	-		0.15	0.05	0.30	0.05	0.83	-	-	0.47	0.33	0.90	0.81	1.00
4	1.05	1.20	-		0.14	0.07	0.34	(0.05)	0.70	-	-	0.65	0.22	1.00	0.83	0.95
5	1.04	1.20	-		0.15	0.02	0.31	0.22	0.96	-	-	0.71	0.03	0.91	0.79	0.95
6	0.89	1.10	-		0.14	0.02	0.34	0.00	0.69	-	-	0.73	0.04	0.91	0.81	0.95
7	0.88	1.00	-		0.12	0.08	0.31	0.01	0.79	-	-	0.56	0.26	0.91	0.80	0.90
8	0.88	1.00	-		0.10	0.08	0.28	0.28	1.06	-	-	0.50	0.35	0.91	0.82	0.95
9	0.88	1.00	-		0.11	0.08	0.28	(0.11)	0.67	-	-	0.48	0.32	0.89	0.80	0.90
10	0.90	1.00	-		0.10	0.07	0.26	(0.01)	0.79	-	-	0.52	0.32	0.91	0.83	1.00
11	0.90	1.00	-		0.09	0.08	0.21	(0.13)	0.67	-	-	0.54	0.30	0.89	0.90	0.95
12	0.88	1.00	-		0.15	<0.01	0.20	0.09	0.87	-	-	0.88	<0.01	0.90	0.90	1.00
13	0.89	1.00	-		0.08	<0.01	0.22	(0.01)	0.78	-	-	0.78	0.12	0.91	0.92	0.95
14	0.91	1.00	-		0.10	0.05	0.21	(0.07)	0.74	-	-	0.63	0.24	0.92	0.94	0.95
15	0.90	1.00	0.35		0.07	0.08	0.21	0.05	0.85	0.17	-	0.56	0.28	0.91	0.85	1.00
16	0.89	1.00	-		0.12	0.08	0.25	0.16	0.95	-	-	0.62	0.23	0.91	0.82	1.00
17	0.88	1.00	-		0.08	0.07	0.20	(0.01)	0.77	-	-	0.63	0.25	0.96	0.83	1.00
18	0.90	1.00	-		0.08	0.06	0.22	(0.08)	0.72	-	-	0.56	0.26	0.87	0.79	0.95
19	0.89	1.00	-		0.12	0.06	0.22	(0.02)	0.77	-	-	0.59	0.22	0.88	0.84	0.95
20	0.88	1.00	-		0.10	0.07	0.24	(0.02)	0.76	-	-	0.52	0.25	0.87	0.91	0.95
21	0.90	1.00	-		0.10	0.08	0.21	(0.18)	0.62	-	-	0.56	0.26	0.88	0.81	0.90
22	0.86	1.00	-		0.15	0.02	0.25	(0.03)	0.73	-	-	0.71	0.11	0.91	0.80	0.95
23	0.88	1.00	-		0.08	0.08	0.21	(0.13)	0.65	-	-	0.60	0.20	0.95	0.84	1.00
24	0.88	1.00	-		0.07	0.08	0.22	(0.09)	0.69	-	-	0.52	0.30	0.89	0.82	1.00
25	0.88	1.00	-		0.10	0.07	0.23	(0.07)	0.71	-	18.0	0.42	0.32	0.80	0.82	0.95
26	0.88	1.00	-		0.12	0.08	0.24	(0.19)	0.59	-	-	0.61	0.21	0.91	0.82	0.95
27	0.86	1.00	-		0.11	0.06	0.23	0.19	0.95	-	-	-	-	0.88	0.91	0.95
28	0.86	1.00	-		0.10	0.08	0.24	(0.12)	0.64	-	-	0.54	0.30	0.91	0.80	0.95
29	0.88	1.00	-		0.11	0.07	0.23	0.03	0.81	-	-	0.60	0.24	0.94	0.81	1.00
30	0.86	1.00	-		0.12	0.07	0.29	0.27	1.03	-	-	0.59	0.28	0.93	0.80	1.00
31	0.86	1.00	-		-	-	0.24	0.46	1.22	-	-	-	-	0.94	0.81	0.95

TABLE 3.2 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/MAY 1985

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	0.90	1.00	-		0.09	0.07	0.22	(0.11)	0.69	-	-	0.64	0.18	0.88	0.80	1.00
2	0.86	1.00	-		0.10	0.07	0.21	0.20	0.96	-	-	0.66	0.16	0.91	0.80	0.95
3	0.90	1.00	-		0.08	0.06	0.21	0.10	0.90	-	-	0.66	0.18	0.89	0.81	0.95
4	0.86	1.00	-		0.10	<0.01	0.20	(0.02)	0.74	-	-	0.64	<0.01	0.87	0.80	0.95
5	0.86	1.00	-		0.12	<0.01	0.23	(0.07)	0.69	-	-	0.83	<0.01	0.89	0.82	0.95
6	0.92	1.00	-		0.10	-	0.21	(0.10)	0.72	-	-	0.72	0.12	0.88	0.86	0.95
7	0.93	1.00	-		0.07	0.06	0.20	0.02	0.85	-	-	-	-	0.75	0.86	1.00
8	0.93	1.00	-		0.06	0.08	0.24	0.19	1.02	-	-	0.66	0.16	0.88	0.84	1.00
9	0.90	1.00	-		0.08	0.07	0.21	0.18	0.98	-	-	-	-	0.91	0.86	1.00
10	0.92	1.00	-		0.09	0.06	0.29	(0.07)	0.75	-	-	0.72	0.12	0.88	0.83	0.95
11	0.88	1.00	-		0.10	-	0.19	0.26	1.04	-	-	0.70	-	0.92	0.86	1.00
12	0.88	1.00	-		0.11	-	0.18	0.02	0.80	-	-	0.68	<0.01	0.87	0.85	1.00
13	1.02	1.10	-		0.08	0.05	0.16	(0.02)	0.80	-	-	0.72	0.12	0.88	0.84	0.95
14	1.12	1.20	0.34		0.10	-	0.24	(0.12)	0.70	0.38	-	0.74	0.14	0.90	0.82	0.95
15	1.10	1.20	-		0.13	0.10	0.28	0.01	0.81	-	-	0.78	0.12	0.93	0.83	1.00
16	1.09	1.20	-		0.16	0.10	0.40	0.02	0.81	-	-	0.68	0.10	0.82	0.86	1.05
17	1.11	1.20	-		0.08	0.06	0.22	0.12	0.93	-	-	0.76	0.09	0.87	0.86	1.00
18	1.09	1.20	-		0.11	0.09	0.26	0.07	0.86	-	-	0.68	0.10	0.88	0.85	1.00
19	1.12	1.20	-		0.09	0.06	0.21	0.06	0.88	-	-	0.68	0.06	0.87	0.83	0.90
20	1.07	1.20	-		0.10	0.06	0.22	0.03	0.80	-	-	0.70	0.12	0.89	0.81	0.90
21	1.10	1.20	-		0.11	0.10	0.27	0.11	0.91	-	-	0.76	0.09	0.88	0.82	0.95
22	1.12	1.20	-		0.08	0.07	0.21	(0.07)	0.75	-	-	0.76	0.08	0.87	0.74	0.95
23	1.10	1.20	-		0.10	0.07	0.21	(0.12)	0.68	-	-	0.76	0.10	0.90	0.86	1.00
24	1.10	1.20	-		0.10	0.09	0.27	(0.18)	0.62	-	-	0.66	0.09	0.80	0.86	0.90
25	1.09	1.20	-		0.12	0.02	0.27	0.32	1.11	-	-	0.75	0.07	0.91	0.84	0.95
26	1.08	1.20	-		0.17	0.01	0.30	0.12	0.90	-	-	0.82	0.05	0.89	0.83	0.95
27	1.07	1.20	-		0.12	0.04	0.28	0.05	0.82	-	-	0.75	0.10	0.91	0.83	0.95
28	1.08	1.20	-		0.13	0.01	0.25	0.10	0.88	-	-	0.83	0.06	0.91	0.84	0.95
29	1.05	1.20	-		0.07	-	0.24	0.10	0.85	-	27.0	0.71	0.11	0.89	0.82	0.95
30	1.12	1.20	-		0.10	0.08	0.21	(0.02)	0.80	-	-	0.72	0.10	0.88	0.82	0.95
31	1.12	1.20	-		0.09	0.10	0.25	0.07	0.89	-	-	0.68	0.10	0.83	0.85	0.95

TABLE 3.2 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/JULY 1985

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.74	1.80	-		0.21	0.07	0.43	(0.26)	0.58	-	-	0.80	0.08	0.90	0.79	1.00
2	1.74	1.80	-		0.22	0.08	0.41	(0.06)	0.78	-	-	0.76	0.08	0.87	0.78	0.95
3	1.75	1.80	-		0.18	0.10	0.38	(0.26)	0.59	-	-	0.81	0.08	0.91	0.79	1.00
4	1.75	1.80	-		0.21	0.09	0.39	0.12	0.97	-	19.0	-	-	0.91	0.80	1.00
5	1.75	1.80	-		0.23	0.12	0.46	(0.04)	0.81	-	-	0.72	0.08	0.82	0.82	1.00
6	1.74	1.80	-		0.08	0.03	0.28	(0.02)	0.82	-	-	0.62	<0.01	0.87	0.79	1.00
7	1.74	1.80	-		0.08	0.04	0.30	(0.04)	0.80	-	-	0.74	<0.01	0.88	0.81	0.95
8	1.75	1.80	-		0.16	0.08	0.37	(0.06)	0.79	-	-	0.80	0.09	0.92	0.80	1.00
9	1.74	1.80	-		0.22	0.06	0.40	(0.02)	0.82	-	-	0.62	0.12	0.80	0.81	1.00
10	1.75	1.80	-		0.21	0.17	0.53	0.11	0.96	-	-	0.72	0.10	0.85	0.81	0.95
11	1.75	1.80	-		0.24	0.08	0.48	0.13	0.98	-	-	0.76	0.08	0.87	0.81	0.95
12	1.73	1.80	-		0.32	0.10	0.53	0.19	1.02	-	-	0.75	0.10	0.88	0.79	0.95
13	1.74	1.80	-		0.25	<0.01	0.43	0.04	0.88	-	-	0.80	0.03	0.90	0.90	0.95
14	1.72	1.80	-		0.19	<0.01	0.38	(0.07)	0.75	-	-	0.72	<0.01	0.88	0.99	1.00
15	1.74	1.80	-		0.16	0.08	0.38	0.21	1.05	-	-	0.74	0.08	0.87	0.91	1.00
16	1.75	1.80	-		0.12	0.07	0.31	(0.07)	0.78	-	-	0.74	0.08	0.87	0.92	1.00
17	1.75	1.80	-		0.24	0.08	0.48	(0.02)	0.83	-	-	0.76	0.08	0.88	0.91	0.95
18	1.76	1.80	-		0.20	0.09	0.36	(0.01)	0.85	-	-	0.66	0.10	0.80	0.92	0.95
19	1.87	1.90	-		0.24	0.10	0.47	0.08	0.95	-	-	0.88	0.05	0.99	0.91	1.00
20	1.95	2.00	-		0.38	0.08	0.58	0.23	1.08	-	-	0.81	0.06	0.90	0.91	1.00
21	1.95	2.00	-		0.36	0.11	0.62	(0.08)	0.77	-	-	0.83	0.06	0.95	0.79	0.95
22	1.95	2.00	-		0.32	0.10	0.56	0.05	0.90	-	-	0.72	0.10	0.88	0.91	0.95
23	1.95	2.00	-		0.16	0.08	0.37	(0.04)	0.81	-	-	0.73	0.08	0.85	0.90	0.95
24	1.94	2.00	-		0.31	0.12	0.54	0.05	0.89	-	-	0.68	0.08	0.80	0.91	1.00
25	1.94	2.00	-		0.33	0.14	0.58	(0.06)	0.78	-	-	0.66	0.10	0.80	0.90	1.00
26	1.95	2.00	-		0.32	0.10	0.57	(0.05)	0.80	-	-	0.79	0.07	0.89	0.89	0.95
27	1.92	2.00	-		0.46	<0.01	0.56	0.15	0.97	-	-	0.87	0.04	0.88	0.93	1.00
28	1.92	2.00	-		0.37	<0.01	0.53	0.21	1.03	-	-	0.88	<0.01	0.91	0.95	0.95
29	1.93	2.00	-		0.42	0.10	0.64	0.29	1.12	-	-	0.84	0.05	0.91	0.93	1.00
30	1.93	2.00	-		0.46	0.10	0.73	0.20	1.03	-	-	0.78	0.01	0.88	0.90	0.95
31	1.95	2.00	-		0.36	0.08	0.59	0.16	1.01	-	-	0.74	0.10	0.87	0.91	0.95

TABLE 3.2 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/OCTOBER 1985

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.94	2.00	-		0.14	0.12	0.37	0.07	0.91	-	-	0.78	0.08	0.89	0.90	1.00
2	1.93	2.00	-		0.18	0.14	0.49	0.01	0.84	-	-	0.76	0.10	0.89	0.95	0.95
3	1.94	2.00	-		0.22	0.13	0.52	0.00	0.84	-	-	0.78	0.08	0.89	0.94	0.95
4	1.94	2.00	-		0.16	0.08	0.38	0.07	0.91	-	-	0.78	0.08	0.88	0.90	1.00
5	1.93	2.00	-		0.33	<0.01	0.45	0.09	0.92	-	-	0.71	<0.01	0.88	0.89	1.00
6	1.92	2.00	-		0.35	<0.01	0.52	0.03	0.85	-	-	0.87	<0.01	0.90	0.90	0.95
7	1.93	2.00	-		0.33	0.16	0.64	0.30	1.13	-	-	0.89	0.08	1.00	0.87	0.95
8	1.92	2.00	-		0.32	0.14	0.56	0.36	1.18	-	-	0.76	0.10	0.90	0.87	1.00
9	1.93	2.00	-		0.36	0.07	0.56	0.04	0.87	-	-	0.80	0.08	0.90	0.85	0.95
10	1.93	2.00	-		0.21	0.12	0.49	(0.01)	0.82	-	-	0.74	0.08	0.88	0.91	1.00
11	1.94	2.00	-		0.38	0.14	0.62	0.10	0.94	-	-	0.74	0.10	0.89	0.93	0.95
12	1.92	2.00	-		0.29	0.14	0.54	0.12	0.94	-	-	0.76	0.10	0.91	0.88	1.00
13	1.94	2.00	-		0.37	0.12	0.54	0.18	1.02	-	-	0.78	0.08	0.90	0.90	1.00
14	1.94	2.00	-		0.32	0.16	0.54	0.15	0.99	-	-	0.78	0.08	0.89	0.91	1.00
15	1.94	2.00	-		0.28	0.08	0.52	0.03	0.87	-	-	0.76	0.08	0.88	0.91	1.05
16	1.93	2.00	-		0.37	0.09	0.56	0.05	0.88	-	-	0.74	0.08	0.88	0.90	1.00
17	1.93	2.00	-		0.28	0.10	0.64	(0.16)	0.67	-	-	0.72	0.10	0.87	0.90	1.00
18	1.94	2.00	-		0.31	0.08	0.57	0.02	0.86	-	-	0.74	0.10	0.88	0.90	1.05
19	1.92	2.00	-		0.34	<0.01	0.57	(0.11)	0.71	-	-	0.78	<0.01	0.90	0.89	1.05
20	1.93	2.00	-		0.35	<0.01	0.60	(0.14)	0.69	-	-	0.81	<0.01	0.89	0.91	1.05
21	1.93	2.00	-		0.32	0.10	0.58	0.09	0.92	-	-	0.80	0.06	0.89	0.92	1.05
22	1.93	2.00	-		0.41	0.11	0.66	0.14	0.97	-	-	0.76	0.08	0.88	0.93	1.00
23	1.92	2.00	-		0.37	0.12	0.58	(0.03)	0.79	-	-	0.78	0.08	0.89	0.90	1.00
24	1.94	2.00	-		0.38	0.10	0.60	(0.08)	0.76	-	-	0.78	0.08	0.90	0.90	1.00
25	1.95	2.00	-		0.27	0.08	0.46	(0.04)	0.81	-	-	0.78	0.08	0.88	0.87	1.05
26	1.94	2.00	-		0.24	0.09	0.46	(0.24)	0.60	-	-	0.78	0.08	0.89	0.86	1.00
27	1.94	2.00	-		0.26	0.08	0.44	0.04	0.88	-	-	0.76	0.09	0.87	0.92	1.00
28	1.93	2.00	-		0.27	0.10	0.44	(0.03)	0.80	-	-	0.81	0.07	0.91	0.88	1.00
29	1.94	2.00	-		0.32	0.12	0.51	(0.15)	0.69	-	17.0	0.82	0.08	0.92	0.91	0.95
30	1.93	2.00	-		0.44	0.10	0.67	(0.13)	0.70	-	-	0.80	0.06	0.89	0.90	1.00
31	1.92	2.00	-		0.46	0.11	0.68	0.10	0.92	-	-	0.80	0.08	0.91	0.90	1.00

TABLE 3.3 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/JANUARY 1984

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.04	1.20	-		<0.01	<0.01	0.45	0.23	0.97	-	-	0.81	0.02	0.90	0.98	1.05
2	1.06	1.20	-		0.10	<0.01	0.12	0.10	0.86	-	-	0.78	<0.01	0.90	1.01	1.00
3	0.81	1.00	-		0.10	0.15	0.42	0.34	1.05	-	-	0.76	0.12	0.95	0.95	1.00
4	0.85	1.00	-		0.12	0.08	0.32	0.07	0.82	-	-	0.68	0.17	0.91	0.98	1.00
5	0.85	1.00	-		0.14	0.06	0.32	0.18	0.93	-	-	0.70	0.15	0.92	0.98	1.00
6	0.85	1.00	-		0.08	0.08	0.24	0.15	0.90	-	-	-	-	0.80	0.97	1.05
7	0.86	1.00	-		0.08	0.09	0.26	0.12	0.88	-	-	0.62	0.20	0.88	0.99	1.05
8	0.83	1.00	-		0.14	0.10	0.31	0.16	0.89	-	-	0.57	0.26	0.92	1.00	1.00
9	0.84	1.00	-		0.10	0.10	0.31	0.11	0.85	-	-	0.52	0.30	0.91	0.98	1.00
10	0.85	1.00	-		0.06	0.12	0.28	0.05	0.80	-	-	0.52	0.28	0.87	0.99	1.00
11	0.86	1.00	-		0.09	0.08	0.27	0.05	0.81	-	-	0.48	0.30	0.82	0.95	1.00
12	0.79	1.00	-		0.10	0.12	0.33	-	-	0.90	0.91	0.47	0.30	0.92		
13	0.56	0.80	-		0.13	0.10	0.36	0.22	0.88	-	-	0.48	0.34	0.92	0.93	1.00
14	0.68	0.80	-		0.07	<0.01	0.17	0.13	0.91	-	-	0.69	0.10	0.87	0.85	0.95
15	0.68	0.80	-		0.12	<0.01	0.17	0.13	0.91	-	-	0.89	<0.01	0.95	0.86	0.90
16	0.68	0.80	-		0.12	0.08	0.23	0.09	0.87	-	-	0.37	0.47	0.90	0.86	0.95
17	0.68	0.80	-		0.09	0.06	0.19	0.13	0.91	-	27.6	0.55	0.32	0.98	0.89	NS
18	1.94	0.00	-		0.08	0.08	0.21	0.02	0.86	-	-	0.32	0.43	0.87	0.90	1.05
19	0.68	0.80	-		0.08	0.10	0.22	0.11	0.89	-	-	0.35	0.48	0.89	0.86	0.95
20	0.67	0.80	-		0.09	0.09	0.23	0.08	0.85	-	-	0.33	0.42	0.83	0.87	0.90
21	0.69	0.80	-		0.11	0.04	0.21	0.03	0.82	-	-	0.33	0.48	0.88	0.85	1.00
22	0.67	0.80	-		0.10	0.07	0.23	0.08	0.85	-	-	0.30	0.53	0.89	0.87	0.95
23	0.66	0.80	-		0.07	0.08	0.22	0.12	0.88	-	-	0.29	0.52	0.88	0.79	1.00
24	0.66	0.80	-		0.07	0.06	0.21	0.12	0.88	-	-	0.29	0.44	0.89	0.87	1.00
25	0.68	0.80	-		0.06	0.06	0.20	0.12	0.90	-	-	0.32	0.46	0.87	0.86	0.95
26	0.80	0.90	-		0.06	0.05	0.15	(0.06)	0.74	-	-	0.28	0.41	0.83	0.86	1.00
27	0.83	1.00	-		0.20	0.03	0.28	0.19	0.92	-	-	0.35	0.50	0.93	0.85	1.00
28	0.75	1.00	-		0.19	0.04	0.32	0.21	0.86	-	-	0.38	0.42	0.93	0.85	1.00
29	0.78	1.00	-		0.15	0.06	0.32	0.24	0.92	-	17.0	0.55	0.24	0.83	0.88	0.95
30	0.77	1.00	-		0.14	0.08	0.32	0.13	0.80	-	-	0.52	0.40	1.18	0.88	0.95
31	0.77	1.00	-		0.08	0.10	0.26	0.13	0.80	-	-	0.35	0.45	0.90	0.88	1.00

TABLE 3.3 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/MAY 1984

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	0.88	1.00	-		0.06	0.08	0.22	0.16	0.94	-	-	0.68	0.17	0.90	0.96	0.95
2	0.87	1.00	-		0.08	0.06	0.23	0.19	0.96	-	-	0.67	0.14	0.88	0.94	1.05
3	0.84	1.00	-		0.08	0.06	0.23	0.20	0.94	-	-	0.69	0.11	0.91	0.91	1.10
4	0.80	1.00	-		0.07	<0.01	0.23	0.24	0.94	-	-	0.80	<0.01	0.90	0.99	1.00
5	0.78	1.00	-		0.13	<0.01	0.32	0.35	1.03	-	-	0.75	<0.01	0.89	0.89	NS
6	0.78	1.00	-		0.10	<0.01	0.28	0.35	1.03	-	-	0.76	0.06	0.91	0.87	1.05
7	0.82	1.00	-		0.08	0.07	0.24	0.10	0.82	-	-	0.75	0.16	0.92	0.82	NS
8	0.82	1.00	-		0.08	0.04	0.19	0.08	0.80	-	-	0.77	<0.01	0.89	0.85	0.90
9	0.83	1.00	-		0.08	-	0.23	0.13	0.86	-	-	0.74	-	-	0.92	0.90
10	0.85	1.00	-		0.08	0.03	0.22	0.22	0.97	-	-	-	-	0.88	0.81	0.95
11	0.83	1.00	-		0.10	<0.01	0.25	0.11	0.84	-	-	0.81	-	0.91	0.79	1.00
12	0.83	1.00	-		0.13	<0.01	0.23	0.11	0.84	-	-	0.76	<0.01	0.88	0.75	0.95
13	0.83	1.00	-		0.10	<0.01	0.24	0.19	0.92	-	-	0.84	<0.01	0.91	0.84	0.95
14	0.82	1.00	-		0.08	0.08	0.20	0.15	0.93	-	-	0.78	-	0.88	0.78	0.95
15	0.87	1.00	-		0.07	0.05	0.22	0.09	0.86	0.13	-	0.68	-	0.87	0.88	1.00
16	0.85	1.00	-		0.08	0.06	0.25	0.08	0.83	-	-	0.66	<0.01	0.88	0.82	1.00
17	0.83	1.00	-		0.12	<0.01	0.27	0.15	0.88	-	-	0.90	-	0.98	0.87	0.95
18	0.89	1.00	-		0.08	0.04	0.25	0.20	0.99	-	-	0.75	-	0.80	0.84	1.00
19	0.85	1.00	-		0.11	0.03	0.23	0.33	1.08	-	-	0.76	0.11	0.93	0.88	1.00
20	0.85	1.00	-		0.08	0.02	0.24	0.33	1.08	-	-	-	-	0.90	0.88	0.95
21	0.85	1.00	-		0.07	0.01	0.23	0.59	1.34	-	-	-	-	0.91	0.86	0.90
22	0.87	1.00	-		0.10	-	0.23	0.21	0.98	-	-	0.72	0.13	0.92	0.80	0.90
23	0.90	1.00	-		0.09	0.07	0.21	0.26	1.06	-	-	0.78	0.14	1.00	0.87	0.95
24	1.05	1.10	-		0.06	0.04	0.15	0.17	1.02	-	-	0.73	-	0.89	0.90	0.95
25	1.12	1.20	-		0.07	0.07	0.24	0.34	1.16	-	-	0.74	0.10	0.90	0.86	0.90
26	1.12	1.20	-		0.07	0.05	0.22	0.12	0.94	-	-	0.74	0.10	0.89	0.85	0.95
27	1.12	1.20	-		0.08	0.04	0.24	0.12	0.94	-	-	0.76	0.08	0.88	0.81	1.00
28	1.10	1.20	-		0.10	0.06	0.26	0.16	0.96	-	-	0.75	0.09	0.89	0.86	1.00
29	1.12	1.20	-		0.09	0.05	0.23	0.24	1.06	-	-	0.73	0.11	0.87	0.90	1.00
30	1.11	1.20	-		0.07	0.06	0.23	0.14	0.95	-	-	0.76	0.08	0.89	0.83	NS
31	1.12	1.20	-		0.09	0.08	0.26	0.11	0.93	-	24.5	0.80	0.08	0.95	0.84	1.05

TABLE 3.3 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/JULY 1984

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.73	1.80	-		0.22	-	0.41	0.27	1.10	-	-	0.70	-	0.85	0.90	1.05
2	1.73	1.80	-		0.12	-	0.40	0.03	0.86	-	-	0.70	-	0.87	0.88	1.00
3	1.72	1.80	-		0.14	0.18	0.48	0.39	1.21	-	-	0.74	0.08	0.88	0.85	0.95
4	1.71	1.80	-		0.12	0.11	0.44	0.33	1.14	-	-	0.76	0.10	0.92	0.94	0.95
5	1.74	1.80	-		0.14	0.12	0.53	0.34	1.18	-	-	0.65	0.15	0.85	0.80	1.00
6	1.75	1.80	-		0.16	0.14	0.57	0.35	1.20	-	-	0.64	0.16	0.88	0.89	1.00
7	1.70	1.80	-		0.15	0.15	0.65	0.38	1.18	-	-	0.70	<0.01	0.90	0.87	1.00
8	1.68	1.80	-		0.28	0.06	0.65	0.56	1.34	-	-	0.79	0.03	0.90	0.85	1.00
9	1.73	1.80	-		0.14	0.08	0.46	0.15	0.98	-	-	0.72	0.14	0.89	0.84	1.00
10	1.71	1.80	0.31		-	-	0.47	0.32	1.13	0.24	-	-	-	0.90	0.80	0.95
11	1.73	1.80	-		0.14	0.11	0.46	0.28	1.11	-	-	0.72	0.14	0.89	0.81	1.00
12	1.72	1.80	-		0.20	0.12	0.54	0.23	1.05	-	-	0.75	0.14	0.92	0.77	0.95
13	1.73	1.80	-		0.15	0.12	0.53	0.33	1.16	-	-	0.74	0.14	0.91	0.78	1.00
14	1.74	1.80	-		0.21	0.13	0.51	0.29	1.13	-	-	0.73	0.12	0.89	0.81	1.00
15	1.76	1.80	-		0.18	0.10	0.42	0.12	0.98	-	-	0.75	0.10	0.88	0.82	0.95
16	1.74	1.80	-		0.17	0.10	0.43	0.32	1.16	-	-	0.74	0.12	0.92	0.80	0.95
17	1.75	1.80	-		0.14	0.10	0.44	0.21	1.06	-	-	0.78	0.13	0.89	0.83	1.00
18	1.76	1.80	-		0.16	0.12	0.38	0.17	1.03	-	-	0.78	0.08	0.88	0.84	1.00
19	1.75	1.80	-		0.13	0.11	0.43	0.28	1.13	-	16.0	0.74	0.11	0.88	0.85	1.00
20	1.75	1.80	-		0.21	0.09	0.47	0.26	1.11	-	-	0.76	0.10	0.90	0.85	0.95
21	1.75	1.80	-		0.19	0.10	0.46	0.29	1.14	-	-	0.74	0.12	0.91	0.87	1.00
22	1.72	1.80	-		-	-	0.66	0.39	1.21	-	-	0.84	0.02	0.92	0.87	1.00
23	1.74	1.80	-		0.22	0.08	-	0.38	1.22	-	-	0.74	0.08	0.89	0.86	0.95
24	1.75	1.80	-		0.23	0.08	0.47	0.22	1.07	-	-	0.72	0.09	0.88	0.82	0.90
25	1.74	1.80	-		0.26	0.10	0.53	0.20	1.04	-	-	0.74	0.11	0.89	0.82	0.90
26	1.74	1.80	-		0.12	0.11	0.36	0.11	0.95	-	-	0.76	0.08	0.89	0.85	0.95
27	1.75	1.80	-		0.17	0.13	0.48	0.34	1.19	-	-	0.75	0.12	0.90	0.88	NS
28	1.74	1.80	-		0.15	-	0.52	0.28	1.12	-	-	0.80	-	0.89	0.92	0.95
29	1.71	1.80	-		0.17	-	0.52	0.29	1.10	-	-	0.82	-	0.86	0.92	NS
30	1.73	1.80	-		0.24	0.09	0.50	0.23	1.06	-	-	0.76	0.11	0.92	0.87	0.95
31	1.73	1.80	-		0.36	0.06	0.57	0.25	1.08	-	-	0.77	0.03	0.90	0.86	0.95

TABLE 3.3 (cont'd): DISINFECTION PROFILE FOR LEMIEUX ISLAND/OCTOBER 1984

DATE	PRE CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3		RESIDUAL Cl_2			Cl_2		NH_3	SO_4	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1	1.92	2.00	-		0.20	0.10	0.42	0.35	1.17	-	-	0.81	0.86	0.92	0.90	1.00
2	1.92	2.00	-		0.54	0.10	0.82	0.52	1.34	-	-	0.78	0.09	0.91	0.89	1.00
3	1.92	2.00	-		0.34	0.10	0.60	0.75	1.57	-	-	0.81	0.09	0.92	0.91	1.05
4	1.92	2.00	-		0.28	0.12	0.54	0.62	1.44	-	-	0.83	0.10	0.95	0.89	1.05
5	1.92	2.00	-		0.34	0.10	0.58	0.20	1.02	-	-	0.83	0.10	0.95	0.89	1.05
6	1.91	2.00	-		0.38	0.08	0.62	0.11	0.92	-	-	0.82	0.08	0.93	0.93	1.05
7	1.90	2.00	-		0.72	0.16	0.98	0.53	1.33	-	-	0.85	0.08	0.93	0.96	1.05
8	1.93	2.00	-		0.47	0.11	0.72	0.37	1.20	-	-	0.84	0.09	0.95	0.91	1.00
9	1.90	2.00	-		0.44	<0.01	0.68	0.45	1.25	-	-	0.85	0.02	0.87	0.94	1.05
10	1.92	2.00	-		0.46	0.08	0.73	0.08	0.90	-	-	0.80	0.10	0.93	0.87	1.05
11	1.92	2.00	-		0.42	0.12	0.72	0.29	1.11	-	-	0.80	0.08	0.92	0.90	1.00
12	1.91	2.00	-		0.30	0.07	0.53	0.33	1.14	-	-	0.79	0.09	0.92	0.88	NS
13	1.92	2.00	-		0.41	0.06	0.62	0.23	1.05	-	-	0.75	0.08	0.91	0.94	1.00
14	1.91	2.00	-		0.54	0.03	0.73	0.39	1.20	-	-	0.83	0.01	0.90	0.93	1.00
15	1.88	2.00	-		0.48	0.05	0.65	0.37	1.15	-	-	0.85	0.02	0.90	0.86	1.00
16	1.90	2.00	-		0.42	<0.01	0.62	0.25	1.05	-	-	0.83	<0.01	0.90	0.86	1.00
17	1.88	2.00	-		0.46	0.07	0.68	0.36	1.14	-	-	0.82	0.02	0.91	0.89	1.05
18	1.93	2.00	-		0.50	<0.01	0.67	0.38	1.21	-	-	0.80	0.03	0.89	0.88	1.05
19	1.90	2.00	-		0.56	0.12	0.86	0.36	1.16	-	-	0.85	0.02	0.92	0.91	1.05
20	1.91	2.00	-		0.45	0.06	0.70	0.04	0.85	-	-	0.85	<0.01	0.90	0.89	1.05
21	1.92	2.00	-		0.45	<0.01	0.63	0.26	1.08	-	-	0.85	<0.01	0.90	0.94	1.05
22	1.90	2.00	-		0.60	0.05	0.82	0.48	1.28	-	-	0.88	<0.01	0.90	0.90	1.00
23	1.90	2.00	-		0.55	0.07	0.82	0.83	1.63	-	-	0.83	<0.01	0.92	0.90	1.00
24	1.90	2.00	-		0.55	<0.01	0.75	0.38	1.18	-	-	0.82	<0.01	0.90	0.87	1.00
25	1.90	2.00	-		0.55	<0.01	0.75	0.34	1.14	-	-	0.92	<0.01	0.96	0.85	1.00
26	1.90	2.00	-		0.30	<0.01	0.54	0.61	1.41	-	23.0	0.82	0.02	0.89	0.80	0.95
27	1.94	2.00	-		0.22	0.08	-	0.54	1.38	-	-	0.82	0.06	0.92	0.87	1.00
28	1.94	2.00	-		0.28	0.10	0.51	0.37	1.21	-	-	0.80	0.08	0.92	0.87	1.00
29	1.94	2.00	-		0.30	0.10	0.54	0.49	1.33	-	-	0.80	0.09	0.92	0.81	1.00
30	1.93	2.00	-		0.22	0.09	0.46	0.26	1.09	0.11	-	0.80	0.10	0.90	0.80	1.05
31	1.92	2.00	-		0.26	0.08	0.44	0.38	1.20	-	-	0.85	0.10	0.98	0.78	0.95

Table 4.0

<u>Legend</u>

W	-	LESS THAN DETECTION LIMIT
T	-	LOW VALUE TENTATIVE
CRO	-	CALCULATED RESULT ONLY
NP	-	NO DATA: NO APPROPRIATE PROCEDURE AVAILABLE
A3C	-	APPROX. RESULT: TOTAL COUNT EXCEEDED 300 COL.
UCR	-	UNRELIABLE: COULD NOT CONFIRM
/SM	-	NO DATA: SAMPLE MISSING

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

GENERAL CHEMISTRY			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
<u>General Chemistry</u>										
Alkalinity	mg/L	R	28.300	26.300	29.300	25.000	25.200	-	0.2 mg/L	
		T	33.500	32.800	30.300	33.200	27.600	-		
Ammonium Total	mg/L	R	.032	.062	.062	.026	.014	-	0.05 mg/L	
		T	.008 T	.026	.014	.004 T	.008 T	-		
Calcium	mg/L	R	10.000	9.400	11.500	10.100	9.000	-	0.1 mg/L	
		T	20.000	19.900	20.500	18.000	19.600			
Chloride	mg/L	R	2.000 T	3.000	3.500	2.000 T	2.000 T	-	0.2 mg/L	250 mg/L
		T	4.000	4.000	5.500	4.000	4.500	-		
Colour	TCU	R	34.500	36.500	32.000	36.000	26.000	-	0.5 TCU	5 TCU
		T	4.000	6.500	4.500	5.000	4.000			
Conductivity		R	86.500	81.500	96.700	81.100	82.100	-	0.01 umho/cm	
	umho/cm	T	144.00	140.00	146.00	132.00	140.00	-		
Field Chlorine		R	-	-	-	-	-	-	0.1 mg/L	
(combined)	mg/L	T	.100	.400	.100	-	-	-		
Field Chlorine		R	-	-	-	-	-	-	0.1 mg/L	
(free)	mg/L	T	1.200	1.000	1.200	-	-	-		
Field Chlorine		R	-	-	-	-	-	-	0.1 mg/L	
(total)	mg/L	T	1.380	1.400	1.300	-	-	-		
Field PH		R	7.100	7.100	7.100	-	-	-	0.2	
		T	8.700	8.300	7.600	-	-	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

GENERAL CHEMISTRY contd			1987						DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			JAN	FEB	MAR	APR	MAY	JUNE		
Field Temperature °C	mg/L	R	3.000	2.000	2.500	-	-	-		
		T	3.000	3.000	2.000	-	-	-		
Field Turbidity	FTU	R	2.000	2.400	2.400	-	-	-		1 FTU
		T	.520	.470	.340	-	-	-		
Flouride	mg/L	R	.060	.060	.070	.060	.030 T	-	0.01 mg/L	2.4 mg/L
		T	.830	.940	.900	.750	.840	-		
Hardness	mg/L	R	34.500	33.000	38.500	35.500	33.000	-	0.5 mg/L	
		T	60.500	60.500	61.000	56.000	59.000	-		
Magnesium	mg/L	R	2.400	2.300	2.300	2.500	2.400	-	0.05 mg/L	
		T	2.550	2.600	2.400	2.600	2.400	-		
Nitrate	mg/L	R	.210	.230	.250	.175	.195	-	0.05 mg/L	10 mg/L as N
		T	.190	.235	.250	.180	.185	-		
Nitrite	mg/L	R	.007	.006	.006	.005	.021	-	0.005 mg/L	1 mg/L as N
		T	.001 T	.003 T	.003 T	.001 T	.003 T	-		
Nitrogen Total Kjeldahl	mg/L	R	.290	.290	.260	.290	.240	-	0.1 mg/L	0.15 mg/L
		T	.150	.110	.070 T	.130	.100	-		
PH		R	7.580	7.500	7.520	7.780	7.720	-		
		T	8.400	8.320	7.720	7.840	8.230	-		
Phosphorus Filtered Reactive	mg/L	R	.002	.003	.003	.003	.004	-	0.01 mg/L	.
		T	.000 T	.003	.003	.006	.004	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

GENERAL CHEMISTRY contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Phosphorus	mg/L	R	.009 T	.011	.012	.018	.009 T	-	0.01 mg/L	
Total		T	.002 T	.009 T	.011	.016	.005 T	-		
Sodium	mg/L	R	2.600	3.200	3.100	2.200	3.600	-	0.1 mg/L	
		T	2.900	3.600	3.400	2.300	3.400	-		
Total Solids	mg/L	R	56.200CRO	67.400	63.200CRO	72.000	53.400CRO	-	1 mg/L	
		T	93.600CRO	91.000CRO	95.000CRO	85.800CRO	91.000CRO			
Turbidity	FTU	R	4.200	3.200	2.900	4.700	1.560	-	0.01 FTU	1 FTU
		T	.280	2.800	.180	.350	.650	-		
<u>Metals</u>										
Aluminum	mg/L	R	.180	.210	.260	.270	.130	-	0.003 mg/L	
		T	.140	.076	.120	.084	.110	-		
Arsenic	mg/L	R	.001	.001	.001	.001	.001	-	0.001 mg/L	0.05 mg/L
		T	.001	.001	.001	.001	.001	-		
Barium	mg/L	R	.016	.017	.017	.018	.016	-	0.001 mg/L	1 mg/L
		T	.015	.014	.015	.017	.016	-		
Beryllium	mg/L	R	.001	.001	.001	.001	.001	-	0.001 mg/L	
		T	.001	.001	.001	.001	.001	-		
Boron	mg/L	R	.020	.020	.020	.010 W	.010 W	-	0.02 mg/L	5 mg/L
		T	.020	.020	.020	.010 W	.010 W	-		
Cadium	mg/L	R	.300	.300	.300	.0003	.0003	-	0.0003 mg/L	0.005 mg/L

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

METALS contd			1987						DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			JAN	FEB	MAR	APR	MAY	JUNE		
Chromium	mg/L	R	.001	.001	.001	.001	.001	-	0.001 mg/L	0.05 mg/L
		T	.001	.001	.001	.001	.001	-		
Cobalt	mg/L	R	.001	.001	.001	.001	.001	-	0.001 mg/L	
		T	.001	.001	.001	.001	.001	-		
Copper	mg/L	R	.007	.009	.009	.016	.010	-	0.001 mg/L	1 mg/L
		T	.001	.001	.001	.001	.002	-		
Cyanide	mg/L	R	.001 W	.001 W	.001 W	.001 W	.001 W	-	0.001 mg/L	0.2 mg/L
		T	.001 W	.001 W	.001 W	.001 W	.001 W	-		
Iron	mg/L	R	.190	.230	.380	.310	.180	-	0.002 mg/L	0.3 mg/L
		T	.015	.020	.022	.022	.010	-		
Lead	mg/L	R	.003	.003	.003	.003	.003	-	0.003 mg/L	0.05 mg/L
		T	.003	.003	.003	.003	.003	-		
Managanese	mg/L	R	.009	.010	.013	.015	.012	-	0.001 mg/L	0.05 mg/L
		T	.005	.010	.010	.009	.012	-		
Molybdenum	mg/L	R	.001 W	.001 W	.001 W	.001 W	.001 W	-	0.001 mg/L	
		T	.001 W	.001 W	.001 W	.001 W	.001 W	-		
Mercury	ug/L	R	.010	.020	.020	.030	.040	-	0.01 ug/L	1 ug/L
		T	.010	.020	.020	.020	.040	-		
Nickel	mg/L	R	.002	.002	.002	.002	.002	-	0.002 mg/L	
		T	.002	.002	.002	.002	.002	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

METALS contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Selenium	mg/L	R	.001	.001	.001	.001	.001	-	0.001 mg/L	0.01 mg/L
		T	.001	.001	.001	.001	.001	-		
Strontium	mg/L	R	.042	.045	.049	.046	.046	-	0.001 mg/L	
		T	.046	.058	.062	.059	.063	-		
Tin		R	.000/NP	.000/NP	.000/NP	.000/NP	.000/NP	-		
(no units available)		T	.000/NP	.000/NP	.000/NP	.000/NP	.000/NP	-		
Uranium	mg/L	R	.200	.100	.200	.080	.080	-	0.002 mg/L	.02 mg/L
		T	.200	.100	.200	.020	.030	-		
Vanadium	mg/L	R	.001 W	.001 W	.001 W	.001 W	.001	-	0.001 mg/L	
		T	.001	.001	.001 W	.001	.001	-		
Zinc	mg/L	R	.004	.003	.001	.004	.004	-	0.001 mg/L	5 mg/L
		T	.017	.002	.006	.003	.005	-		
<u>Purgeables</u>										
Benzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Bromoform	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Carbon	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	3 ug/L
Tetrachloride		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Chlorobenzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ng/L	100-300 ng/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

PURGEABLES contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Chlorodi-	ug/L	R	.001 W	.001 W	.001 W	.001 W	.001 W	.001 W	1 ug/L	350 ug/L
bromoethane		T	.001 W	.001 W	.001 W	.001 W	.001 W	.001 W		
Chloroform	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
		T	69.000	48.000	55.000	70.000	104.00	124.00		
1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,3	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,4	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Dichloro-	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
bromomethane		T	1.000	1.000	1.000	1.000	1.650	2.900		
1,1	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	
Dichloroethane		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
Dichloroethane		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,1	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	.3 ug/L
Dichloroethylene		T	.000APS	.000 W	.000 W	.000 W	.000 W	.000 W		
T,1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	
Dichloroethylene		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

PURGEABLES contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Dichloro-	ug/L	R	-	-	-	.000 W	.000 W	.000/CS	5 ug/L	40 ug/L
methane		T	-	-	-	.000 W	.000 W	.000/CS		
1.2	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	
Dichloropropane		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Ethylbenzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	1400
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		ug/L
Ethylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Dibromide		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
M-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
O-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
P-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Toluene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	100 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,1,2,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	1.7 ug/L
Tetrachloroethane		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Tetrachloro-	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
ethylene		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

PURGEABLES contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
1,1,1 Trichloroethane	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	1000 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
1,1.2 Trichloroethane	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	6 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Trichloro-ethylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	30 ug/L
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
Total Trihalomethanes	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	3 ug/L	350 ug/L
		T	70.000	50.000	56.000	71.000	105.65	126.90		
Trifluoro-chlorotoluene	ug/L	R	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W	1 ug/L	
		T	.000 W	.000 W	.000 W	.000 W	.000 W	.000 W		
<u>Organochlorines</u>										
Aldrin	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	700 ng/L
		T	1.000	1.000	1.000	1.000	-	-		
Alpha BHC	ng/L	R	2.000 T	-	3.000 T	1.000 T	-	-	1 ng/L	700 ng/L
		T	1.000 T	2.000 T	4.000 T	1.000 T	-	-		
Alpha Chlordane	ng/L	R	2.000 W	-	2.000 W	2.000 W	-	-	2 ng/L	300 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W	-	-		
Beta BHC	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	300 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
Dieldrin	ng/L	R	2.000 W	-	2.000 W	2.000 W	-	-	2 ng/L	700 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W	-	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

ORGANOCHLORINES contd			1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Endrin	ng/L	R	4.000 W	-	4.000 W	4.000 W	-	-	1 ng/L	200 ng/L
		T	4.000 W	4.000 W	4.000 W	4.000 W	-	-		
Gamma Chlordane	ng/L	R	2.000 W	-	2.000 W	2.000 W	-	-	2 ng/L	700 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W	-	-		
Heptachlor Epoxide	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	3000 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
Heptachlor	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	3000 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
Hexachloro-benzene	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	10 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
Hexachloro-Butadiene	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-		
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
Hexachloro-ethane	ng/L	R	3.000 T	-	1.000 W	1.000 W	-	-	1 ng/L	19000 ng/L
		T	5.000 T	5.000 T	1.000 W	2.000 T	-	-		
Lindane	ng/L	R	1.000 W	-	1.000 W	-	-	-	1 ng/L	4000 ng/L
		T	1.000 W	1.000 W	1.000 W	-	-	-		
Methoxychlor	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	100000 ng/L
		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		
Mirex	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

ORGANOCHLORINES contd			1987						DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			JAN	FEB	MAR	APR	MAY	JUNE		
Octachlorostyrene		R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	
	ng/L	T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
O,P-DDT	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	30000 ng/L
		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		
Oxychlordane	ng/L	R	2.000 W	-	2.000 W	2.000 W	-	-	2 ng/L	
		T	2.000 W	2.000 W	2.000 W	2.000 W	-	-		
PCB Total	ng/L	R	20.000 W	-	20.000 W	20.000 W	-	-	20 ng/L	3000 ng/L
		T	20.000 W	20.000 W	20.000 W	20.000 W	-	-		
Pentachlorobenzene		R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	74000
	ng/L	T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		ng/L
P,P-DDD	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		
P,P-DDE	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	
		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
P,P-DDT	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		ng/L
1,2,3,4-	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	
Tetrachlorobenzene		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		
1,2,3,5-	ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	
Tetrachlorobenzene		T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

ORGANOCHLORINES contd		1987						DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
		JAN	FEB	MAR	APR	MAY	JUNE		
1,2,4,5 ng/L	R	1.000 W	-	1.000 W	1.000 W	-	-	1 ng/L	38000
Tetrachlorobenzene	T	1.000 W	1.000 W	1.000 W	1.000 W	-	-		ng/L
Thidan I ng/L	R	2.000 W	-	2.000 W	2.000 W	-	-	2 ng/L	74000
	T	2.000 W	2.000 W	2.000 W	2.000 W	-	-		ng/L
Thidan II ng/L	R	4.000 W	-	4.000 W	4.000 W	-	-	4 ng/L	74000
	T	4.000 W	4.000 W	4.000 W	4.000 W	-	-		ng/L
Thidan Sulphate ng/L	R	4.000 W	-	4.000 W	4.000 W	-	-	4 ng/L	
	T	4.000 W	4.000 W	4.000 W	4.000 W	-	-		
Toxaphene	R	.000/NP	-	.000/NP	.000/NP	-	-		
(no units available)	T	.000/NP	.000/NP	.000/NP	.000/NP	-	-		
1,2,3 ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	10000
Trichlorobenzene	T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		ng/L
1,2,4 ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	15000
Trichlorobenzene	T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		ng/L
1,3,5 ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	10000
Trichlorobenzene	T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		ng/L
2,3,6 ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	
Trichlorotuluene	T	5.000 W	11.000 W	5.000 W	5.000 W	-	-		
2,4,5 ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	10000
Trichlorotuluene	T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		ng/L

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

ORGANOCHLORINES contd			1987						DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			JAN	FEB	MAR	APR	MAY	JUNE		
2,6,A	ng/L	R	5.000 W	-	5.000 W	5.000 W	-	-	5 ng/L	
Trichlorotuluene		T	5.000 W	5.000 W	5.000 W	5.000 W	-	-		
Triazines										
Alachlor	ng/L	R	500.00 W	500.00 W	500.00 W	-	-	-		
		T	500.00 W	500.00 W	500.00 W	-	-	-		
Ametrine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Aratone	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Atrazine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	46000 ng/L
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Bladex	ng/L	R	100.00 W	100.00 W	100.00 W	100.00 W	-	-	100 ng/L	10000 ng/L
		T	100.00 W	100.00 W	100.00 W	100.00 W	-	-		
Metolachlor	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Prometone	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Prometryne	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	1000 ng/L
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
Propazine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	
		T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		

TABLE 4.0: LEMIEUX ISLAND WATER QUALITY/1987

TRIAZINES contd		1987 JAN	FEB	MAR	APR	MAY	JUNE	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Sencor ng/L	R	100.00 W	100.00 W	100.00 W	100.00 W	-	-	100 ng/L	
	T	100.00 W	100.00 W	100.00 W	100.00 W	-	-		
Simazine ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	-	-	50 ng/L	10000 ng/L
	T	50.000 W	50.000 W	50.000 W	50.000 W	-	-		
BACTERIA									
Raw Water									
Total Coliform MF count/mL	R	110.00	88.000A3C	110.00A3C	63.000A3C	300.00	-		
Total Coliform BKGD count/mL	R	120.00	14800.0	920.00	380.00	2100.0	-		
Fecal Coliform MF count/mL	R	23.000	17.000	12.000	39.000	23.000	21.000	0	0/0.1 mL
Standard Plate Count MF count/ml	R	980.00	880.00	1900.0	340.00	320.00	2400.0	0	500
Treated Water									
Present/Absent Test	T	A	A	A	A	A	A		
Total Coliform Background MF count/ml	T	.000	.000	.000	.000	.000	.000	0	OWDO Bactl
Standard Plate Count MF count/ml	T	1.000	.000	4.000	2.000	.000	.000		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

GENERAL CHEMISTRY			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
General Chemistry								
Alkalinity	mg/L	R	33.500	30.000	24.700	27.500	0.2 mg/L	
		T	31.800	31.200	26.900	33.400		
Ammonium Total	mg/L	R	.002 W	0.016	.008 T	.020	0.05 mg/L	
		T	0.002 W	0.008 T	.002 W	.002 W		
Calcium	mg/L	R	11.500	10.000	8.900	10.100	0.1 mg/L	
		T	20.800	19.400	17.700	20.700		
Chloride	mg/L	R	-	-	-	2.500	0.2 mg/L	250 mg/L
		T	-	-	-	5.000		
Colour	TCU	R	32.000	39.000	37.500	37.000	0.5 TCU	5 TCU
		T	2.500	3.000	4.000	6.000		
Conductivity	umho/ cm	R	97.300	90.100	82.300	87.200	0.01 UMHO/ CM	
		T	156.00	149.00	137.00	151.00		
Field Chlorine (combined)	mg/L	R	-	-	-	-	0.1 mg/L	
		T	.300	.100	.050	.200		
Field Chlorine (Free)	mg/L	R	-	-	-	-	0.1 mg/L	
		T	1.000	1.400	1.400	1.200		
Field Chlorine (Total)	mg/L	R	-	-	-	-	0.1 mg/L	
		T	1.300	1.500	1.450	1.400		
Field PH		R	7.400	7.300	7.100	7.200	0.2	
		T	8.000	8.300	8.300	8.300		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

GENERAL CHEMISTRY contd			1986 SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Field Temperature	°C	R	16.000	12.000	4.200	2.400		
		T	16.500	12.500	4.000	3.100		
Field Turbidity	FTU	R	2.300	1.500	2.000	1.900		1 FTU
		T	2.100	.900	.480	.750		
Fluoride	mg/L	R	.060	.080	.050 T	.060	0.01 mg/L	2.4 mg/L
		T	1.080	.050 T	.840	.670		
Hardness	mg/L	R	38.500	35.000	31.000	35.000	0.5 mg/L	
		T	62.500	59.500	54.500	62.000		
Magnesium	mg/L	R	2.450	2.500	2.200	2.400	0.05 mg/L	
		T	2.600	2.650	2.400	2.500		
Nitrate	mg/L	R	.165	.235	.350	.265	0.05 mg/L	10 mg/L
		T	.170	.240	.320	.235		as N
Nitrite	mg/L	R	.003	.006	.004 T	.016	0.005 mg/L	1 mg/L
		T	.000 T	.002 T	.001 W	.005		as N
Nitrogen Total	mg/L	R	.340	.120UCR	.220	.200	0.1 mg/L	0.15 mg/L
Kjeldahl		T	.140	.100UCR	.040 T	.130		
PH		R	7.820	7.820	7.810	7.790		
		T	7.960	7.210	7.860	7.960		
Phosphorus	mg/L	R	.002 T	.002	.002 T	.002	0.01 mg/L	
Filtered Reactive		T	.002 T	.003	.003	.001 T		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

GENERAL CHEMISTRY contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Phosphorus Total	mg/L	R	.013	.005 T	.014	.008 T	0.01 mg/L	
		T	.005 T	.013	.013	.002 W		
Sodium	mg/L	R	3.200	2.800	2.100	2.800	0.1 mg/L	
		T	3.200	2.900	2.600	3.100		
Total Solids	mg/L	R	78.000	70.000	66.800CRO	66.800	1 mg/L	
		T	100.20CRO	97.000CRO	89.200CRO	95.400		
Turbidity FTU		R	2.300	2.300	3.900	1.960	0.01 FTU	1 FTU
		T	3.500	1.550	.230	.290		
<u>Metals</u>								
Aluminum	mg/L	R	.280	.130	.190	.140	0.003 mg/L	
		T	.033	.130	.170	.310		
Arsenic	mg/L	R	.001	.001	.001	.001	0.001 mg/L	0.05 mg/L
		T	.001	.001	.001	.001		
Barium	mg/L	R	.019	.019	.015	.017	0.001 mg/L	1 mg/L
		T	.017	.017	.014	.015		
Beryllium	mg/L	R	.001	.001	.001	.001	0.001 mg/L	
		T	.001	.001	.001	.001		
Boron	mg/L	R	.020	.020	.020	.020	0.02 mg/L	5 mg/L
		T	.020	.020	.020	.020		
Cadium	mg/L	R	.400	.300	.400	.300	0.0003 mg/L	0.005 mg/L
		T	.400	.300	.400	.300		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

METALS contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Chromium	mg/L	R	.001	.001	.001	.001	0.001 mg/L	0.05 mg/L
		T	.001	.001	.001	.001		
Cobalt	mg/L	R	.001 ·	.001	.001	.001	0.001 mg/L	
		T	.001	.001	.001	.001		
Copper	mg/L	R	.008	.007	.007	.007	0.001 mg/L	1 mg/L
		T	.012	.003	.002	.002		
Cyanide	mg/L	R	.001 W	.001 W	.001 W	.001 W	0.001 mg/L	0.2 mg/L
		T	.001 W	.001 W	.001 W	.001 W		
Iron	mg/L	R	.240	.270	.230	.220	0.002 mg/L	0.3 mg/L
		T	.010	.017	.021	.022		
Lead	mg/L	R	.004	.003	.003	.003	0.003 mg/L	0.05 mg/L
		T	.004	.003	.003	.003		
Manganese	mg/L	R	.014	.015	.012	.013	0.001 mg/L	0.05 mg/L
		T	.005	.009	.008	.006		
Holybdenum	mg/L	R	.001 W	.001 W	.001 W	.001 W	0.001 mg/L	
		T	.001 W	.001 W	.001 W	.001 W		
Mercury	ug/L	R	.010	.010	.010	.010	0.01 ug/L	1 ug/L
		T	.010	.010	.010	.010		
Nickel	mg/L	R	.002	.002	.002	.002	0.002 mg/L	
		T	.002	.002	.002	.002		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

METALS contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Selenium	mg/L	R	.001	.001	.001	.001	0.001 mg/L	0.01 mg/L
		T	.001	.001	.001	.001		
Strontium	mg/L	R	.056	.051	.039	.041	0.001 mg/L	
		T	.060	.069	.053	.044		
Tin		R	.000NP	.000NP	.000NP	.000NP		
(no units available)		T	.000NP	.000NP	.000NP	.000NP		
Uranium	mg/L	R	.100	.080	.100	.200 T	0.002 mg/L	.02 mg/L
		T	.080	.040	.050	.200 T		
Vanadium	mg/L	R	.001	.001 W	.001	.001	0.001 mg/L	
		T	.001	.001 W	.001	.001		
Zinc	mg/L	R	.013	.005	.002	.003	0.001 mg/L	5 mg/L
		T	.025	.001 W	.001	.002		
<u>Purgeables</u>								
Benzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Bromoform	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Carbon	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	3 ug/L
Tetrachloride		T	.000 W	.000 W	.000 W	.000 W		
Chlorobenzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ng/L	100-300 ng/L
		T	.000 W	.000 W	.000 W	.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

PURGEABLES contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Chloro-	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
dibromomethane		T	.000 W	.000 W	.000 W	.000 W		
Chloroform	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
		T	189.00	165.00	140.00	107.00		
1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W		
1,3	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W		
1,4	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	400 ug/L
Dichlorobenzene		T	.000 W	.000 W	.000 W	.000 W		
Dichlorobromo-	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	350 ug/L
methane		T	3.000	2.000	1.000	1.000		
1,1	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	
Dichloroethane		T	.000 W	.000 W	.000 W	.000 W		
1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
Dichloroethylene		T	.000 W	.000 W	.000 W	.000 W		
1,1	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	.3 ug/L
Dichloroethylene		T	.000 W	.000 W	.000 W	.000 W		
1,1,2	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	
Dichloroethylene		T	.000 W	.000 W	.000 W	.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

PURGEABLES contd			1986 SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Dichloromethane	ug/L	R	-	-	-	-	5 ug/L	40 ug/L
		T	-	-	-	-		
1,2 Dichloropropane	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	
		T	.000 W	.000 W	.000 W	.000 W		
Ethylbenzene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	1400 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Ethylene Dibromide	ug/L	R	.000 W	.000 W	.000 W	.000 W		
		T	.000 W	.000 W	.000 W	.000 W		
M-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
O-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
P-Xylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	620 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Toluene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	100 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
1,1,2,2 Tetrachloroethane	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	1.7 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Tetrachloro-thylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	10 ug/L
		T	.000 W	.000 W	.000 W	.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

PURGEABLES contd			1986 SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
1,1,1 Triochloroethane	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	1000 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
1,1,2 Trichloroethane	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	6 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Trichloro- Ethylene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	30 ug/L
		T	.000 W	.000 W	.000 W	.000 W		
Total Trihalomethanes	ug/L	R	.000 W	.000 W	.000 W	.000 W	3 ug/L	350 ug/L
		T	192.00	167.00	141.00	108.00		
Trifluoro- chlorotoluene	ug/L	R	.000 W	.000 W	.000 W	.000 W	1 ug/L	
		T	.000 W	.000 W	.000 W	.000 W		
<u>Organochlorines</u>								
Aldrin	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	700 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W		
Alpha BHC	ng/L	R	1.000 T	1.000 W	2.000 T	1.000 T	1 ng/L	700 ng/L
		T	2.000 T	1.000 T	2.000 T	1.000 T		
Alpha Chlordane	ng/L	R	2.000 W	2.000 W	2.000 W	2.000 W	2 ng/L	700 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W		
Beta BHC	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	300 ng/L
		T	1.000 W	1.000 W	2.000 T	1.000 W		
Dieldrin	ng/L	R	2.000 W	2.000 W	2.000 W	2.000 W	2 ng/L	700 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

ORGANOCHLORINES contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Endrin	ng/L	R	4.000 W	4.000 W	4.000 W	4.000 W	4 ng/L	200 ng/L
		T	4.000 W	4.000 W	4.000 W	4.000 W		
Gamma Chlordane	ng/L	R	2.000 W	2.000 W	2.000 W	2.000 W	2 ng/L	700 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W		
Heptachlor Epoxide	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	3000 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W		
Heptachlor	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	3000 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W		
Hexachloro- benzene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	10 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W		
Hexachloro- butadiene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W		
		T	1.000 W	1.000 W	1.000 W	1.000 W		
Hexachloroethane	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	19000 ng/L
		T	1.000 W	1.000 W	10.000	1.000 W		
Lindane	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	4000 ng/L
		T	1.000 W	1.000 W	8.000 T	1.000 W		
Methoxychlor	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	100000 ng/L
		T	5.000 W	5.000 W	5.000 W	5.000 W		
Mirex	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

ORGANOCHLORINES contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Octachlorostyrene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	
		T	1.000 W	1.000 W	1.000 W	1.000 W		
O,P-DDT	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	30000 ng/L
		T	5.000 W	5.000 W	5.000 W	5.000 W		
Oxychlordane	ng/L	R	2.000 W	2.000 W	2.000 W	2.000 W	2 ng/L	
		T	2.000 W	2.000 W	2.000 W	2.000 W		
PCP Total	ng/L	R	20.000 W	20.000 W	20.000 W	20.000 W	20 ng/L	3000 ng/L
		T	20.000 W	20.000 W	20.000 W	20.000 W		
Pentachloro-benzene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	74000 ng/L
		T	1.000 W	1.000 W	1.000 W	1.000 W		
P,P-DDD	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W		
P,P-DDE	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	
		T	1.000 W	1.000 W	1.000 W	1.000 W		
P,P-DDT	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	
		T	5.000 W	5.000 W	5.000 W	5.000 W		
1,2,3,4 Tetrachlorobenzene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	
		T	1.000 W	1.000 W	1.000 W	1.000 W		
1,2,3,5 Tetrachlorobenzene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	
		T	1.000 W	1.000 W	1.000 W	1.000 W		

TABLE 4.1: BRITANNIA WATER QUALITY-1986

ORGANOCHLORINES contd			1986 SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
1,2,4,5-Tetrachlorobenzene	ng/L	R	1.000 W	1.000 W	1.000 W	1.000 W	1 ng/L	38000 ng/L
		T	1.000 W	1.000 W	10.000	1.000 W		
Thiodan I	ng/L	R	2.000 W	2.000 W	2.000 W	2.000 W	2 ng/L	74000 ng/L
		T	2.000 W	2.000 W	2.000 W	2.000 W		
Thiodan II	ng/L	R	4.000 W	4.000 W	4.000 W	4.000 W	4 ng/L	74000 ng/L
		T	4.000 W	4.000 W	4.000 W	4.000 W		
Thiodan Sulphate		R	4.000 W	4.000 W	4.000 W	4.000 W	4 ng/L	
	ng/L	T	4.000 W	4.000 W	4.000 W	4.000 W		
Toxaphene		R	.000NP	.000NP	.000NP	.000NP		
(no units available)		T	.000NP	.000NP	.000NP	.000NP		
1,2,3-Trichlorobenzene		R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	10000 ng/L
	ng/L	T	5.000 W	5.000 W	5.000 W	5.000 W		
1,2,4-Trichlorobenzene		R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	15000 ng/L
	ng/L	T	5.000 W	5.000 W	5.000 W	5.000 W		
1,3,5-Trichlorobenzene		R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	10000 ng/L
	ng/L	T	5.000 W	5.000 W	5.000 W	5.000 W		
2,3,6-Trichlorotoluene		R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	
	ng/L	T	5.000 W	5.000 W	5.000 W	5.000 W		
2,4,5-Trichlorotoluene		R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	10000 ng/L
	ng/L	T	5.000 W	5.000 W	5.000 W	5.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

ORGANOCHLORINES contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
2,6,A-	ng/L	R	5.000 W	5.000 W	5.000 W	5.000 W	5 ng/L	
Trichlorotoluene		T	5.000 W	5.000 W	5.000 W	5.000 W		
Triazines								
Alachlor	ng/L	R	500.00 W	500.00 W	500.00 W	500.00 W		
		T	500.00 W	.000NR	500.00 W	500.00 W		
Ametrine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	50 ng/L	
		T	50.000 W	.000NR	50.000 W	50.000 W		
Atratone	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W		
		T	50.000 W	.000NR	50.000 W	50.000 W		
Atrazine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	50 ng/L	46000 ng/L
		T	50.000 W	.000NR	50.000 W	50.000 W		
Bladex	ng/L	R	300.00 T	100.00 W	100.00 W	100.00 W	100 ng/L	10000 ng/L
		T	100.00 W	.000NR	50.00 W	50.00 W		
Metolachlor	ng/L	R	500.00 W	500.00 W	500.00 W	500.00 W		
		T	500.00 W	.000NR	500.00 W	500.00 W		
Prometone	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	50 ng/L	
		T	50.000 W	.000NR	50.000 W	50.000 W		
Prometryne	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	50 ng/L	1000 ng/L
		T	50.000 W	.000NR	50.000 W	50.000 W		
Propazine	ng/L	R	50.000 W	50.000 W	50.000 W	50.000 W	50 ng/L	
		T	50.000 W	.000NR	50.000 W	50.000 W		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

TRIAZINES cont'd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
Sencor	ng/L	R	100.00 W	100.00 W	100.00 W	100.00 W	100 ng/L	
		T	100.00 W	.000NR	100.00 W	100.00 W		
Simazine	ng/L	R	50.000 T	50.000 W	50.000 W	50.000 W	50 ng/L	10000 ng/L
		T	50.000 W	.000NR	50.000 W	50.000 W		
Special Pesticides								
2,4,-D	ng/L	R	-	100.00 W	-	-	100 ng/L	100000 ng/L
		T	-	100.00 W	-	-		
2,4,-D Butyric Acid		R	-	200.00 W	-	-	200 ng/L	18000 ng/L
	ng/L	T	-	200.00 W	-	-		
Dicamba	ng/L	R	-	100.00 W	-	-	100 ng/L	87000 ng/L
		T	-	100.00 W	-	-		
Pentachlorophenol	ng/L	R	-	.000/CS	-	-	50 ng/L	10000 ng/L
		T	-	50.000 W	-	-		
Picloram	ng/L	R	-	.000/NP	-	-	100 ng/L	
		T	-	.000/NP	-	-		
2,4-D Propionic Acid		R	-	100.00 W	-	-	100 ng/L	
		T	-	100.00 W	-	-		
Silvex	ng/L	R	-	50.000 W	-	-	50 ng/L	10000 ng/L
		T	-	50.000 W	-	-		
2,4,5-T	ng/L	R	-	50.000 W	-	-	50 ng/L	
		T	-	50.000 W	-	-		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

SPECIAL PESTICIDES contd			1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
			SEPT	OCT	NOV	DEC		
2,3,4,5-Tetrachlorophenol	ng/L	R	-	50.000 W	-	-	500 ng/L	
		T	-	50.000 W	-	-		
2,3,5,6-Tetrachlorophenol	ng/L	R	-	50.000 W	-	-	50 ng/L	
		T	-	50.000 W	-	-		
2,3,4-Trichlorophenol	ng/L	R	-	100.00 W	-	-	100 ng/L	
		T	-	100.00 W	-	-		
2,4,5-Trichlorophenol	ng/L	R	-	50.000 W	-	-	50 ng/L	
		T	-	50.000 W	-	-		
2,4,6-Trichlorophenol	ng/L	R	-	50.000 W	-	-	50 ng/L	10000 ng/L
		T	-	90.000 T	-	-		
<u>Organophosphorus Pesticides</u>								
Diazinon	ng/L	R	-	20.000 W	-	-	50 ng/L	14000 ng/L
		T	-	.000/SM				
Dichlorovos	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM				
Dursban	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		
Ethion	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		
Guthion	ng/L	R	-	.000/NP	-	-		
		T	-	.000/NP	-	-		

TABLE 4.1: LEMIEUX ISALND WATER QUALITY-1986

ORGANOPHOSPHORUS PESTICIDES contd			1986 SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
Halathion	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		
Methylparathion		R	-	20.000 W	-	-	50 ng/L	7000 ng/L
		T	-	.000/SM	-	-		
Methyltrithion	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		
Mevinphos	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		
Parathion	ng/L	R	-	20.000 W	-	-	50 ng/L	35000 ng/L
		T	-	.000/SM	-	-		
Phorbate	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM				
Reldan	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM				
Ronnel	ng/L	R	-	20.000 W	-	-		
		T	-	.000/SM	-	-		

TABLE 4.1: LEMIEUX ISLAND WATER QUALITY-1986

BACTERIA		1986				DWSP DETECTION LIMIT	DRINKING WATER OBJ/ GUIDELINE
		SEPT	OCT	NOV	DEC		
Raw Water							
Total Coliform MF count/100mL	R	176.00A3C	300.00	1200.0	82.000A3C		
Total Coliform BKGD count/100mL	R	14000.00	8600.0	2000.0	3700.00		
Fecal Coliform MF count/100mL	R	116.00	40.000	68.000	13.000	0	0/0.1 mL
Standard Plant Count MF count/100mL	R	.000/AW	2400.0	2400.0	2400.0	0	500
Treated Water							
Present/Absent Test	T	A	A	A	A		
Total Coliform Back-Ground MF count/100mL	T	.000	1.000	.000	.000	0	OWDO Bacti
Fecal Coliform FM count/100mL	T	.000/AW	.000	2.000	1.000		
Standard Plate Count MF count/100mL	T	.000/AW	3.000	.000	1.000		

TABLE 5.0: ALGAE COUNT FOR LEMIEUX ISLAND

MONTH	COUNT (ASU)			
	1986	1985	1984	1983
JAN	36	34	16	31
FEB	17	10	14	ND
MAR	9	5	45	64
APR	ND	6	38	40
MAY	286	105	42	10
JUN	15	13	28	232
JUL	55	67	372 (1)	18
AUG	19	13	29	18
SEP	25	9	29	11
OCT	26	11	16	52
NOV	10	140	85	39
DEC	14	41	19	113

(1) Pediaistrum accounts for 243 counts

ND - No data

TABLE 6.0: BACTERIOLOGICAL TESTING (1986) LEMIEUX ISLAND

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM				
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500
JAN	R	0	0	0	31	0	0	18	5	8	0
	T	31	0	0	0	0	31	0	0	0	0
FEB	R	0	0	8	20	0	0	18	3	7	0
	T	28	0	0	0	0	28	0	0	0	0
MAR	R	0	0	18	13	0	0	28	2	1	0
	T	31	0	0	0	0	31	0	0	0	0
*APR	R	0	0	10	19	0	0	20	0	9	0
	T	29	0	0	0	0	29	0	0	0	0
MAY	R	0	0	9	22	0	0	8	0	23	0
	T	31	0	0	0	0	31	0	0	0	0
JUN	R	0	0	6	24	0	0	0	2	28	0
	T	30	0	0	0	0	30	0	0	0	0
*JUL	R	0	0	3	27	0	0	2	1	27	0
	T	30	0	0	0	0	30	0	0	0	0
AUG	R	0	0	6	25	0	0	1	0	30	0
	T	31	0	0	0	0	31	0	0	0	0
SEP	R	0	0	3	27	0	0	0	0	30	0
	T	30	0	0	0	0	30	0	0	0	0
*OCT	R	0	0	0	0	0	0	0	0	0	0
	T	0	0	0	0	0	0	0	0	0	0
NOV	R	0	0	2	28	0	0	0	0	30	0
	T	30	0	0	0	0	30	0	0	0	0
DEC	R	0	0	0	31	0	0	0	0	31	0
	T	31	0	0	0	0	31	0	0	0	0

R = Raw; T = Treated; * = Samples Missing
All results are for 100 ml samples

TABLE 6.1: BACTERIOLOGICAL TESTING (1985) LEMIEUX ISLAND

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM				
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500
JAN	R	0	0	0	31	0	0	0	3	28	0
	T	31	0	0	0	0	31	0	0	0	0
*FEB	R	0	0	0	27	0	0	0	0	27	0
	T	27	0	0	0	0	27	0	0	0	0
MAR	R	0	0	0	31	0	0	4	2	25	0
	T	31	0	0	0	0	31	0	0	0	0
APR	R	0	0	12	18	0	0	6	2	22	0
	T	30	0	0	0	0	30	0	0	0	0
MAY	R	0	0	14	17	0	0	3	2	26	0
	T	31	0	0	0	0	31	0	0	0	0
JUN	R	0	0	16	14	0	0	5	3	22	0
	T	30	0	0	0	0	30	0	0	0	0
JUL	R	0	0	4	27	0	0	0	0	31	0
	T	31	0	0	0	0	31	0	0	0	0
AUG	R	0	0	11	19	0	0	1	0	29	0
	T	30	0	0	0	0	30	0	0	0	0
SEP	R	0	0	7	23	0	0	1	1	28	0
	T	30	0	0	0	0	30	0	0	0	0
OCT	R	0	1	1	29	0	0	1	0	30	0
	T	31	0	0	0	0	31	0	0	0	0
NOV	R	0	0	0	30	0	0	0	0	30	0
	T	30	0	0	0	0	30	0	0	0	0
DEC	R	0	0	4	27	0	0	7	3	21	0
	T	31	0	0	0	0	31	0	0	0	0

R = Raw; T = Treated; * = Samples Missing
All results are for 100 ml samples

TABLE 6.2: BACTERIOLOGICAL TESTING (1984) LEMIEUX ISLAND

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM				
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500
JAN	R	0	0	2	29	0	0	10	1	20	0
	T	31	0	0	0	0	31	0	0	0	0
FEB	R	0	0	0	29	0	0	6	1	22	0
	T	29	7	0	0	0	29	0	0	0	0
MAR	R	0	0	3	28	0	0	1	0	30	0
	T	31	0	0	0	0	31	0	0	0	0
APR	R	0	0	8	22	0	0	2	0	28	0
	T	30	0	0	0	0	30	0	0	0	0
MAY	R	0	0	14	17	0	0	0	0	31	0
	T	31	0	0	0	0	31	0	0	0	0
JUN	R	0	0	26	3	0	0	4	7	20	0
	T	30	0	0	0	0	30	0	0	0	0
JUL	R	0	0	26	5	0	0	9	2	20	0
	T	31	0	0	0	0	31	0	0	0	0
AUG	R	0	0	13	18	0	0	7	3	21	0
	T	31	0	0	0	0	31	0	0	0	0
SEP	R	0	0	3	27	0	0	6	3	21	0
	T	30	0	0	0	0	30	0	0	0	0
OCT	R	0	1	0	31	0	0	2	0	29	0
	T	31	0	0	0	0	31	0	0	0	0
*NOV	R	0	0	0	30	0	0	1	0	29	0
	T	30	0	0	0	0	30	0	0	0	0
DEC	R	0	0	0	31	0	0	0	0	31	0
	T	31	0	0	0	0	31	0	0	0	0

R = Raw; T = Treated; * = Samples Missing
All results are for 100 ml samples

TABLE 6.3: BACTERIOLOGICAL TESTING (1983) LEMIEUX ISLAND

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM				
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500
JAN	R	0	0	3	28	0	0	0	1	30	0
	T	31	0	0	0	0	31	0	0	0	0
FEB	R	0	0	2	26	0	0	0	1	27	0
	T	28	0	0	0	0	28	0	0	0	0
*MAR	R	0	0	10	20	0	0	0	4	26	0
	T	30	0	0	0	0	30	0	0	0	0
APR	R	0	0	30	0	0	0	0	17	13	0
	T	30	0	0	0	0	30	0	0	0	0
MAY	R	0	0	19	11	0	0	0	11	19	0
	T	31	0	0	0	0	31	0	0	0	0
*JUN	R	0	0	10	18	0	0	0	4	24	0
	T	28	0	0	0	0	28	0	0	0	0
JUL	R	0	0	7	24	0	0	4	2	25	0
	T	31	0	0	0	0	31	0	0	0	0
*AUG	R	0	0	9	20	0	0	4	0	26	0
	T	30	0	0	0	0	30	0	0	0	0
SEP	R	0	0	10	20	0	0	4	3	23	0
	T	30	0	0	0	0	30	0	0	0	0
*OCT	R	0	0	0	30	0	0	0	2	28	0
	T	30	0	0	0	0	30	0	0	0	0
*NOV	R	0	0	1	29	0	0	9	3	18	0
	T	30	0	0	0	0	30	0	0	0	0
DEC	R	0	0	1	30	0	0	11	3	17	0
	T	31	0	0	0	0	31	0	0	0	0

R = Raw; T = Treated; * = Samples Missing
All results are for 100 ml samples

APPENDIX B
JAR TESTING RESULTS

INTRODUCTION

Chemical coagulation of water is typically evaluated using a six-place stirring apparatus produced by Phipps and Bird, Inc. A major purpose of jar testing for water treatment plant operations is to determine the coagulant dose and mixing intensity which produces the lowest settled water turbidity.

Jar tests can range from very simple comparative experiments using standard 1.0 or 2.0 L glass beakers to complex multivariate, multi-level experiments using specially designed flocculator jars.

The purpose of the jar test study conducted for the Lemieux Island Water Treatment Plant was to simulate the process conditions to determine if there were any short-comings in the plant operation. The Lemieux plant was undergoing maintenance operations in the clearwell and filters during the period of the jar tests. Consequently, the plant only ran at night.

METHODS AND MATERIALS

Apparatus and Materials

- Phipps and Bird, Inc. 6-place stirrer with water bath and light box
- 6, 2.0 L glass beakers
- 4, 1.0 L square gator jars
- Hach Ratio Turbidimeter MODEL 18900
- Fisher Accumet pH Meter MODEL 325
- LKB Biochrom Ultra Spectrophotometer MODEL 4050
- 1 cm quartz cuvette
- Whatman No 42 filter
- Millipore membrane filter
- 200 mm deep, 18 mm diameter monomedia sand filter, effective grain size 0.9

Reagents

- o Liquid alum with a 48.5% solution of $Al_2(SO_4)_3 \cdot 14\ H_2O$, ρ = 1330 kg/m³

- o Stock alum solution, 1.0% as $Al_2(SO_4)_3 \cdot 14\ H_2O$ (10 mg/mL)

- o Stock activated silica solution, 0.05% (0.5 mg/mL)

- o Stock polyaluminum chloride, 0.1% (1.0 mg/mL)

- o 0.2 N sulphuric acid

Procedure

1. The stock alum solution was freshly prepared each day by diluting 15.4 mL of liquid alum to 1.0 L with distilled water. The resulting concentration was 10 mg/mL.

2. The stock activated silica solution was prepared from National Silicates Laboratory test solutions according to their instructions 5.0 ml of sodium silicate solution was added to 10 mL of distilled water. To this mixture, 5.0 mL of ammonium sulphate solution was added. The resulting solution aged 8 to 12 min. before diluting to 1.0 L with distilled water. The resulting concentration of activated silica was 0.5 mg/mL.

3. Instruments were calibrated as required according to the manufacturers instructions.

4. 2.0 L of raw Ottawa River water (12.5°C) was added to each of the unbaffled, 2.0 L glass beakers following determination of turbidity and ultraviolet absorbance. In tests 6 and 7, 1.0 L gator jars were used in place of the beakers.

5. The beakers were placed in a flow-through water bath to maintain the sample water temperature at the river water temperature.

6. Rapid mixing was achieved by stirring the beaker contents at 100 RPM for 60 seconds.

7. Flocculation conditions consisted of 30 min of contact at 20 RPM.

8. At the end of the flocculation period, the Phipps and Bird apparatus was switched off and the jars permitted to settle for 30 min.

9. Approximately 400 to 600 mL of supernatant were decanted from the jar at the end of the sedimentation period.

10. Selected samples of supernatent were filtered through the monomedia sand filter, the Whatman filter, and the Millipore filter.

11. Turbidity was determined using Method 214A from Standard Methods (Ref. B-1).

12. Ultraviolet absorbance (UVA) was determined at 254 nm using a 1 cm light path. No sample preparation was performed. The blank was prepared from ASTM Type I, HPLC grade laboratory water.

RESULTS

Test 1 - Bench-Scale Filter Evaluation

The objective of Test 1 was to select the most suitable filtration material. The experimental conditions and results are given in Table B1. Filtration tests were performed on the jar exhibiting best settling.

Table B1

Results of Test 1

Jar	1	2	3	4	5	6
Alum Dose, mg/L	20	26	33	20	26	33
Activated Silica Dose, mg/L	0.75	0.75	0.75	0.75	0.75	0.75
Final pH		6.4				
Settled Water Turbidity, FTU		1.4				
Filtered Water Turbidity, FTU						
Sand		0.45				
Whatman		0.35				
Millipore		0.25				
Filtered Water UVA						
Sand		0.370	Note: UVA is being employed as a surrogate for organic content.			
Whatman		0.347				
Millipore		0.338				

The floc size and quantity increased as alum and activated silica doses increased. As the sand filter aged, filtrate quality improved with turbidity dropping to 0.10 FTU and the UVA declining to 0.337.

The final pH of jar 2 at plant dosage conditions was slightly higher when compared with the plant filtrate pH. This was because the jar test sample had not been pre-chlorinated. The Whatman and Millipore filters were withdrawn from future tests in favour of the sand filter because the sand filter more accurately represented the plant process.

Test 2 - Effect of Final pH

Test 2 was conducted to determine the effect of final pH on the coagulation/flocculation/filtration process. The experimental conditions and results are provided in the following table.

Results of Test 2

Jar	1	2	3	4	5	6
Alum Dose, mg/L	22	26	30	22	26	30
Activated Silica Dose mg/L	0.75	0.75	0.75	0.75	0.75	0.75
Final pH	6.3	6.2	5.9	5.5	5.5	5.0
Sulphuric Acid Dose, mg/L	3.9	3.9	3.9	11.8	11.8	11.8
Settled Water Turbidity, FTU	-	1.1	1.3	-	1.4	-
Filtered Water Turbidity, FTU	0.20	0.10	0.35	0.10	0.10	0.20
Filtered Water UVA	-	0.338	-	-	0.337	-

Raw water turbidity and ultraviolet absorbance were 3.9 FTU and 0.523, respectively.

The best floc formation and settling characteristics were observed in jars 4 and 5. The alum dose was similar to the plant dose. However, the final pH was somewhat lower than is typically seen in the plant. The poorest floc was formed at the lowest alum dose and the highest final pH. It is interesting to note that the best settled water turbidity was observed in jar 2 (the plant condition), yet the supernatant from jar 5 had the lowest filtrate turbidity. The floc formed in jar 5 evidently had the best filterability characteristic.

Test 3 - Comparison of Bench-Scale and Full-Scale Flocculation

The objective of Tests 3 to 5 was to compare jar test results with actual plant performance. In Test 3, water samples were collected from the inlet to the three flocculation streams in the plant. These samples had already been chemically treated and mixed in the plant. They are denoted as plant samples 1B, 2B, 3B. The other three jars were treated as shown below. Jar 2 had chemical doses equivalent to the plant conditions under which samples 1B, 2B, and 3B had been collected. The experimental conditions and results are tabulated as follows:

Results of Test 3

Plant Sample* Jar	 1	 2**	 3	1B 4	2B 5	3B 6
Alum Dose, mg/L	24	26	28	26	26	26
Activated Silica Dose mg/L	0.75	0.75	0.75	0.75	0.75	0.75
Final pH	-	6.2	6.2	6.2	-	-
Sulphuric Acid*** Dose, mg/L	3.9	3.9	3.9	-	-	-
Settled Water Turbidity, FTU	-	1.1	1.0	0.95	-	-
Filtered Water Turbidity, FTU	-	0.10	0.15	0.10	-	-
Filtered Water UVA	-	0.338	0.333	0.335	-	-

* Plant sampling at 109 ML/d, maximum day 227 ML/d
** Jar 2 same as plant conditions
*** Sulphuric acid was used to adjust pH

Raw water turbidity and ultraviolet absorbance were 3.9 FTU and 0.523, respectively. Comparing the results of jars 2 and 3 with jar 4 reveals no significant difference between the samples obtained from the plant and the ones prepared at bench-scale.

Test 4 - Comparison of Bench-Scale and Full-Scale Settleability

The objective of Test 4 was to collect coagulated and flocculated water from the plant to determine the settled water characteristics after 30 min of sedimentation. A sample was obtained at the inlet to the sedimentation basins. The results are tabulated below.

Results of Test 4

Settled Water Turbidity, FTU	1.3
Filtered Water Turbidity, FTU	0.10
Filtered Water UVA	0.340
pH	6.1

Raw water turbidity and ultraviolet absorbance were 3.9 FTU and 0.523, respectively. These results are very similar to those of Test 3 suggesting that the bench-scale processes are similar to the full-scale processes.

Test 5 - Comparison of Bench-Scale and Full-Scale Filterability

The purpose of Test 5 was to determine the filterability of the water collected from the top of the rapid sand filters using the bench-scale sand filter. The results are as follows:

Results of Test 5

Settled Water Turbidity, FTU	0.95
Filtered Water Turbidity, FTU	0.10
Filtered Water UVA	0.336
pH	6.1

The raw water turbidity and ultraviolet absorbance were 3.9 FTU and 0.523, respectively. The results are similar to those from Tests 3 and 4 indicating the similarity between the bench-scale and full-scale processes.

Test 6 - Evaluation of Polyaluminum Chloride Dose

The objective of Test 6 was to evaluate polyaluminum chloride as the primary coagulant. The procedures used in this experiment were identical to the previous tests except the water bath was not used for temperature control and 1.0 L gator jars were used in place of the 2.0 L unbaffled beakers. The experimental conditions in Test 6a are tabulated below:

Experimental Conditions for Test 6a

Jar	1	2	3	4
Polyaluminum Chloride Dose, mg/L	15	20	25	30
Activated Silica Dose, mg/L	0.75	0.75	0.75	0.75
Final pH	6.1	6.1	6.1	6.1
Sulphuric Acid* Dose, mg/L	9.8	9.8	9.8	9.8

* Sulphuric acid was used for pH adjustment

All four jars formed small floc with poor settling characteristics.

Test 6b was conducted under a different set of experimental conditions as shown below. Results are also included:

Results of Test 6b

Jar	1	2	3	4
Polyaluminum Chloride Dose, mg/L	15	15	15	15
Activated Silica Dose, mg/L	1.0	2.0	3.0	4.0
Final pH	6.1	6.1	6.1	6.1
Sulphuric Acid* Dose, mg/L	9.8	9.8	9.8	9.8
Settled Water Turbidity, FTU	-	1.1	1.1	-
Filtered Water Turbidity, FTU	-	0.15	0.15	-
Filtered Water UVA	-	0.382	0.380	-

* Sulphuric acid was used to adjust pH to optimum for coagulation.

The raw water turbidity and ultraviolet absorbance were 3.9 FTU and 0.542, respectively. Jars 2 and 3 had the best settling floc.

<u>Test 7 - Comparison of Alum with Polyaluminum Chloride</u>

Test 7 was conducted to compare alum with polyaluminum chloride. Alum coagulation and flocculation was performed in the 2.0 L glass beakers whereas the polyaluminum chloride was evaluated in 1.0 L gator jars. The experimental conditions and results are tabulated below.

Results of Test 7

Jar	1	2	3	4	5	6
*PACl = polyaluminum chloride						
Primary coagulant Type	PACl*	PACl	ALUM	ALUM	PACl	PACl
Primary Coagulant Dose, mg/L	15	15	28	28	20	20
Activated Silica Dose, mg/L	2.0	2.0	0.75	0.75	2.0	2.0
Final pH	5.7	6.1	6.0	6.0	5.2	6.0
Sulphuric Acid Dose, mg/L	14.7	9.8	4.9	2.9	14.7	9.8
Settled Water Turbidity, FTU	0.80	0.35	1.7	1.6	0.45	0.35
Filtered Water Turbidity, FTU	0.10	0.10	0.10	0.10	0.10	0.05
Filtered Water UVA	0.371	0.372	0.352	0.349	0.346	0.358

It is evident that there was a significant improvement in settled water turbidity when using polyaluminum chloride compared with alum. However, filtered water turbidities were essentially the same when using either coagulant. These results are at some variance with other experience with PACL. In general PACL has shown poor settling in full scale tests but better overall performance.

DISCUSSION

Bench-scale Filter Evaluation

The purpose of Test 1 was to determine the filter medium most representative of the full-scale, dual media, rapid sand filters in the plant. It was found that the filtration rate through the two membrane-type filters was too low

relative to the plant. Once the monomedia sand filter had ripened, its performance was very consistent relative to the full-scale plant performance. Therefore, it was concluded that the bench-scale filter would be suitable for evaluating changes in the filterability of floc formed during the jar test results.

<u>Selection of Coagulant Dose and Final pH</u>
The objective of Test 2 was to evaluate the effects of alum dose and final pH on the settleability and filterability of Ottawa River water.

The best floc formation and settling characteristics were observed in jars 4 and 5, where pH was approximately 5.5 and the alum dose was 22 to 26 mg/L. The theoretical optimum pH for alum coagulation by enmeshment in a sweep floc is approximately 5.5 (Ref. B-2). As can be expected from theory, the lowest alum dose at the highest pH, had the least favourable floc formation and settling characteristics (jar 1). Jars 2 and 6 were very similar in appearance. It is interesting to note that the best settled water turbidity was associated with jar 2 and that the best filtered water turbidity was observed using supernatant from jar 5. This suggests that properly pre-treated water many not have the lowest settled water turbidity but can produce a floc which has a high affinity for removal by rapid sand filtration.

Therefore, it may be worthwhile to consider pH adjustment of the raw water prior to coagulation with the goal of improving the filterability of the aluminum hydroxide floc. Furthermore, the optimum pH for removal of organic precursors of trihalomethanes is typically lower than that for turbidity removal (Ref. B-3). Thus, many benefits can accrue as a result of coagulation at a lower pH than is currently being used.

Comparison of Bench-Scale and Full-Sized Performance

Tests 3 to 5 were performed to evaluate the similarity between results obtained at bench-scale and those observed at full-scale. Test 3 compared coagulation performance.

It was found that there was no discernable difference in the settleability or filterability of the samples which were coagulated at bench-scale and those coagulated at full-scale.

Test 4 compared the settleability of coagulated and flocculated water collected from the full-scale processes with that from the bench-scale tests. There was no detectable difference between the settled and filtered water characteristics from this test and those observed in Test 3.

Test 5 compared the filterability of settled water collected from the filter box with that produced in the bench-scale experiments. There was no apparent difference in the treated water characteristics.

It was found throughout these three experiments that the bench-scale testing was representative of the in-plant performance.

Evaluation of Polyaluminum Chloride

A number of advantages have been associated with the use of polyaluminum chloride when charge neutralization is the predominant mechanism of colloidal destabilization (Ref. B-4). However, polyaluminum chloride is significantly more expensive than alum. Tests 6a, 6b, and 7 were conducted to evaluate the potential for polyaluminum chloride as a primary coagulant for Ottawa River waters.

It was found that poor floc formation was characteristic of polyaluminum chloride over the range of doses (15 to 30 mg/L) used in Test 6a when the activated silica dose was the

same as currently used in the plant, 0.75 mg/L. This is likely because the principal colloidal removal mechanism is enmeshment in a sweep aluminum hydroxide floc. However, addition of up to four times more activated silica at a polyaluminum chloride dose of 15 mg/L produced a floc which settled and filtered as well as the alum floc (alum dose 26 mg/L, activated silica dose 0.75 mg/L). The extra surface area provided by the activated silica produced a settleable floc comparable to the aluminum hydroxide floc.

Side-by-side comparison of alum and polyaluminum chloride (Test 7) revealed no significant difference in the filtrate turbidity. However, the settled water turbidity was significantly lower when the polyaluminum chloride was used with 2.0 mg/L of activated silica. Therefore, it is likely that increased filter run lengths would be anticipated. However, the addition of 2.0 mg/L of activated silica would exacerbate the sludge handling problems in the clarifiers. The increased chemical cost resulting from the use of polyaluminum chloride and higher doses of activated silica, combined with higher sludge volumes, in return for no difference in filtrate turbidity, mitigate against considering polyaluminum chloride as an alternative to alum.

CONCLUSIONS

The evidence provided by the jar testing study supports the hypothesis that the Lemieux Island Water Treatment plant is consistently capable of producing low turbidity ($\sim$ 0.2 FTU) filtered water. However, optimization of chemical doses and the final pH of the coagulation process is possible. In addition, there is sufficient evidence in the literature (Ref. B-3) indicating that a large proportion of tritralomethane (THM) precursors can be removed by an optimized coagulation process, typically at pH values lower

than are presently maintained at the Britannia Plant. Therefore it is recommended that a jar test study using the apparatus described in Ref. B-5 and the surrogate parameters for organics described by Ref. B-6 be undertaken to determine the optimum pH and chemical doses with the objective of minimizing chemical costs and maximizing turbidity and organics removal.

The use of ozone as a pre-oxidant and for enhancement of the coagulation process should be investigated as part of the same experimental program since ozone has been shown to reduce the quantity of alum required for coagulation and to reduce the THM formation potential in some waters (Ref. B-7).

REFERENCES

B-1 *Standard Methods for the Examination of Water and Wastewater*, 15th edition. Washington, DC: American Public Health Association, 1981.

B-2 Weber, W.J., *Physicochemical Processes for Water Quality Control*. New York, NY: John Wiley & Sons, 1972.

B-3 Committee Report. Organics Removal by Coagulation: A Review and Research Needs. *Journal of the American Water Works Association*. 77, 10(1979): 588-603.

B-4 Dempsey, B.A., R.M. Ganho, and C.R. O'Melia. The Coagulation of Himic Substances by Means of Aluminum Salts. *Journal of the American Water Works Association*. 76, 4(1984): 141-150.

B-5 Hudson, H.E. and E.G. Wagner. Conduct and Use of Jar Tests. *Journal of the American Water Works Association*. 73(1981): 218-223.

B-6 Edzwald, J.K., W.L. Becker, and K.L. Wattier. Surrogate Parameters for Monitoring Organic Matter and THM Precursors. *Journal of the American Water Works Association*. 77,4(1985): 122-132.

B-7 Glaze, W.H. Drinking Water Treatment with Ozone. *Environmental Science and Technology*. 21,3 (1987): 224-230.

APPENDIX C

DAILY LOG SHEETS

QUALITY CONTROL DAILY ROUTINES

'LANT BRITANNIA MONTH , 1987

	PRE-CHLORINE			FI #1 CHLORINE			FI #7 CHLORINE			FI CHLORINE				FE CHLORINE				POST-CHLORINE			RC	IAC?	LIME	IOID	LT	
DAY	FREE	MONO	TOTAL	FREE	MONO	TOTAL	FREE	MONO	TOTAL	NO.	FREE	MONO	TOTAL	NO.	FREE	MONO	TOTAL	FREE	MONO	TOTAL	pH	pH	FIXED	IND.	COLOUR	REMARKS
1																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
16																										
17																										
18																										
19																										
20																										
21																										
22																										
23																										
24																										
25																										
26																										
27																										
28																										
29																										
30																										
31																										

REMARKS:

QUALITY CONTROL LOG SHEET

PLANT MONTH , 1987

	RAW WATER						SETTLING BASIN			FILTER EFFLUENT						PLANT EFFLUENT						
DAY	TEMP.	COND.	pH	T. ALK.	TURB.	COLOUR	IN. TURB.	EF. TURB.	TSET.	NO.	pH	T. ALK.	TURB.	COLOUR	CL2	pH	T. ALK.	TURB.	COLOUR	CL2	FLUOR.	DAY
1																						1
2																						2
3																						3
4																						4
5																						5
6																						6
7																						7
8																						8
9																						9
10																						10
11																						11
12																						12
13																						13
14																						14
15																						15
16																						16
17																						17
18																						18
19																						19
20																						20
21																						21
22																						22
23																						23
24																						24
25																						25
26																						26
27																						27
28																						28
29																						29
30																						30
31																						31

REMARKS:

APPENDIX D

TERMS OF REFERENCE

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.

2. Document the quality and quantity of raw and treated waters.

3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.

4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.

5. Assess current disinfection practices and possible improvement methods.

6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.

7. Prepare a draft report for the project committee's review.

8. Prepare the final report.

1. RECEIVE AN INFORMATION PACKAGE FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF, IF REQUIRED, TO DISCUSS THE PROJECT.

<u>Elements of Work</u>

(a) Receive an information package from the MOE concerning the plant and the study. This package includes a general terms of reference, a general table of contents for organizing the study in a manner consistent with other plant reports, the WPOS reporting tables and a copy of Ontario Drinking Water Objectives.

(b) Review the information and prepare for a meeting to initiate the work on the project, including preparation of a schedule of manpower and staff committments.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule. If a consultant is carrying out more that one study it may not be necessary to meet with the MOE at the start of each study.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

Elements of Work

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum/iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Tables 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and, size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of inplant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. Appendix B is an example of the required standard schematic.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

5. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

6. DESCRIBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL.

Elements of Work

(a) Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost and possible schedule for implementation for each of the proposed modifications.

It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

(b) Incorporate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (8 COPIES).

Elements of Work

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix C) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) Meet with the Project Committee on site at least one week after submission of the report.

(c) Prepare a separate letter report containing recommendation(s) concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. PREPARE THE FINAL REPORT.

Elements of Work

(a) Conduct additional field testing if required. Discuss the implementations of the results with the Project Committee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporating additional field data if required.

(c) Submit 25 copies of the final reports (including the colour photographs) to the MOE for distribution.